

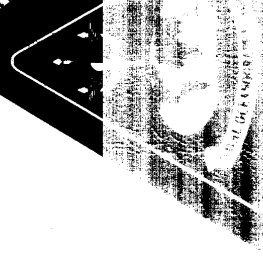
**EASTERN—WESTERN
ARCTIC SEA ICE ANALYSES
1991**

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**PREPARED BY
NAVAL POLAR OCEANOGRAPHY CENTER
SUITLAND, MD**

**PREPARED UNDER AUTHORITY OF
COMMANDER, NAVAL OCEANOGRAPHY COMMAND
STENNIS SPACE CENTER, MS 39529-5000**

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FOREWORD

The U.S. Navy has a long and eventful history of polar exploration from Robert E. Peary in the Arctic to Richard E. Byrd in the Antarctic. In recent years the strategic importance and expanded research pursuits in these areas have resulted in greater national and international requirements for environmental information. Since 1976, the National Oceanic and Atmospheric Administration (NOAA) and the Navy have worked together at the Joint Ice Center (JIC) in Suitland, Maryland. By combining the Navy's experience in observing and recording sea ice data, and NOAA's expertise in satellite data collection and interpretation, the JIC has been able to keep pace with that demand in both polar regions.

This publication is the 18th edition of the Arctic sea ice atlases prepared by the JIC. The atlas contains weekly charts depicting Northern Hemisphere and Great Lakes ice conditions and extent. The significant use of high resolution satellite imagery, combined with valuable ice reconnaissance data from various sources, has greatly improved the accuracy of these analyses.

The purpose of this atlas is to provide the user with reliable weekly hemispheric ice analyses. Both Navy and NOAA personnel with considerable experience in sea ice analysis prepare the analyses. The following procedures have been developed to ensure the quality of the final products:

- a. Conventional shore station, ship and aerial ice reconnaissance observations are plotted and evaluated.
- b. Satellite data from different sensors is compared and analyzed for ice information content. Table I, located on the inside back cover, summarizes satellite data availability for 1991.
- c. A final product results from a. and b. However, where insufficient data is available, an estimated boundary will be depicted. Meteorological data and computer generated ice drift vectors are utilized to determine the estimated ice edge position.

NAVY/NOAA Joint Ice Center
Naval Polar Oceanography Center
4301 Suitland Road
Washington, DC 20395-5180

REPORT DOCUMENTATION PAGE

Form Approved

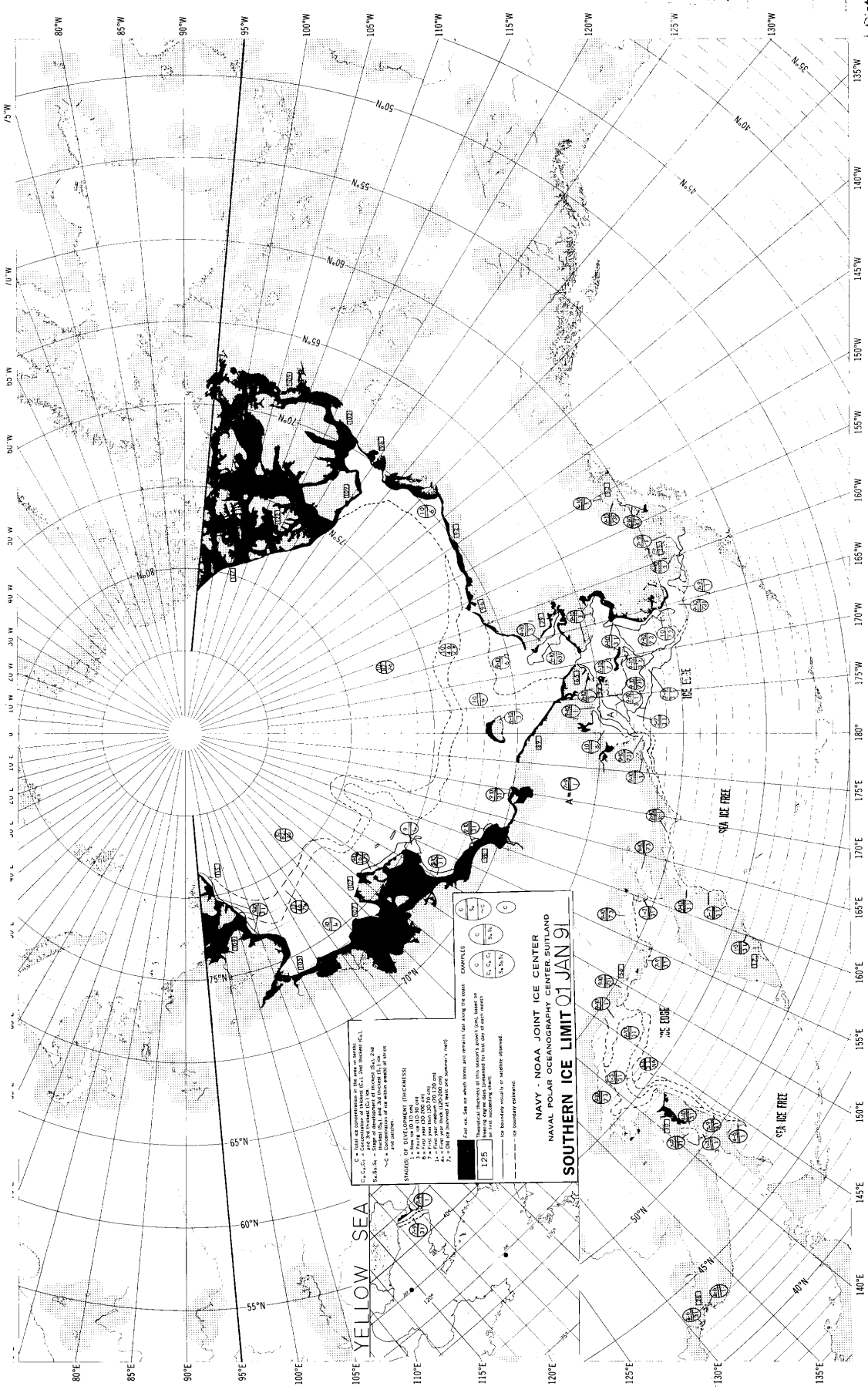
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YELLOW SEA

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105°W 110°W 115°W 120°W 125°W 130°W 135°W

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SOUTHERN ICE LIMIT 01 JAN 91

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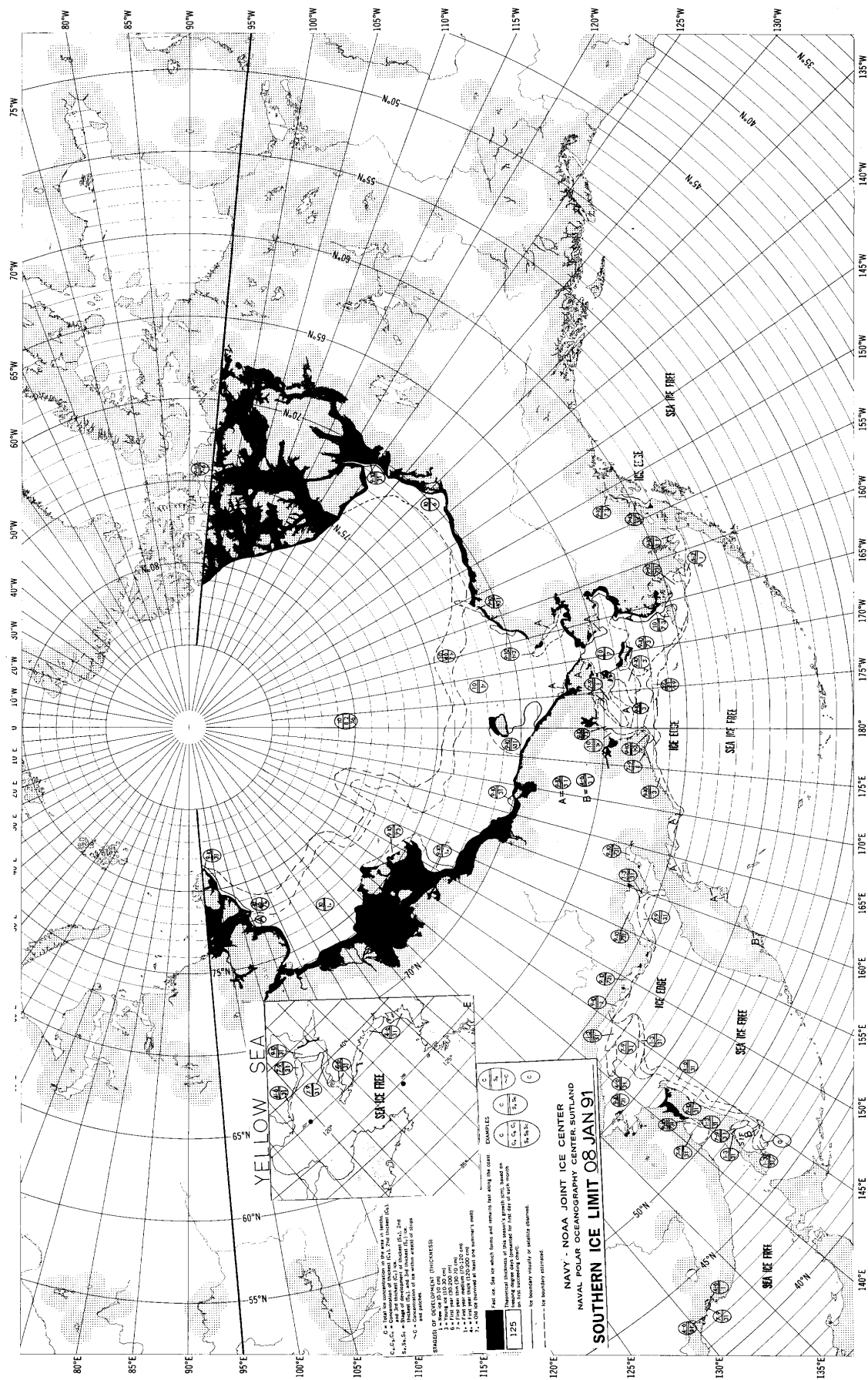
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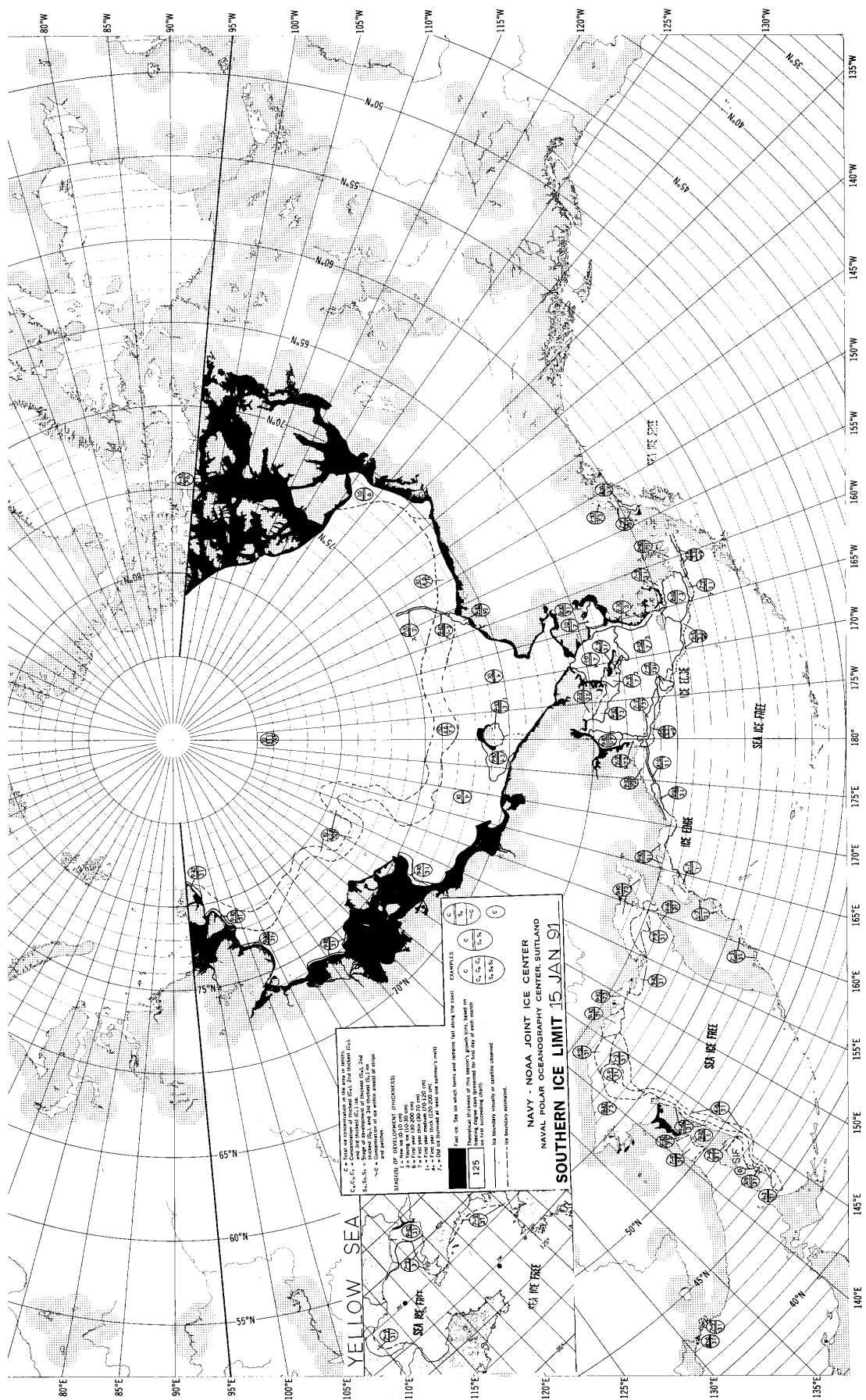
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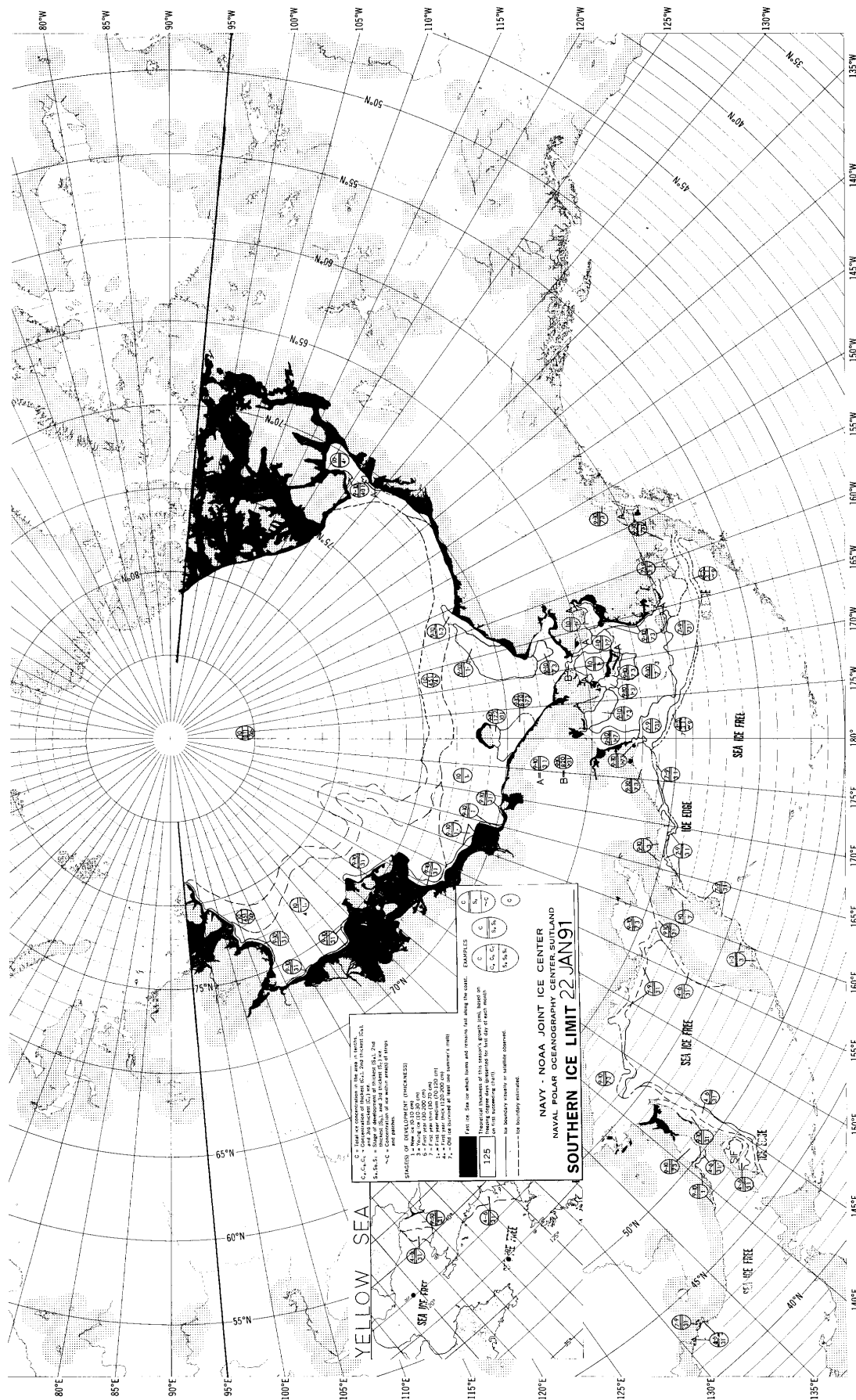
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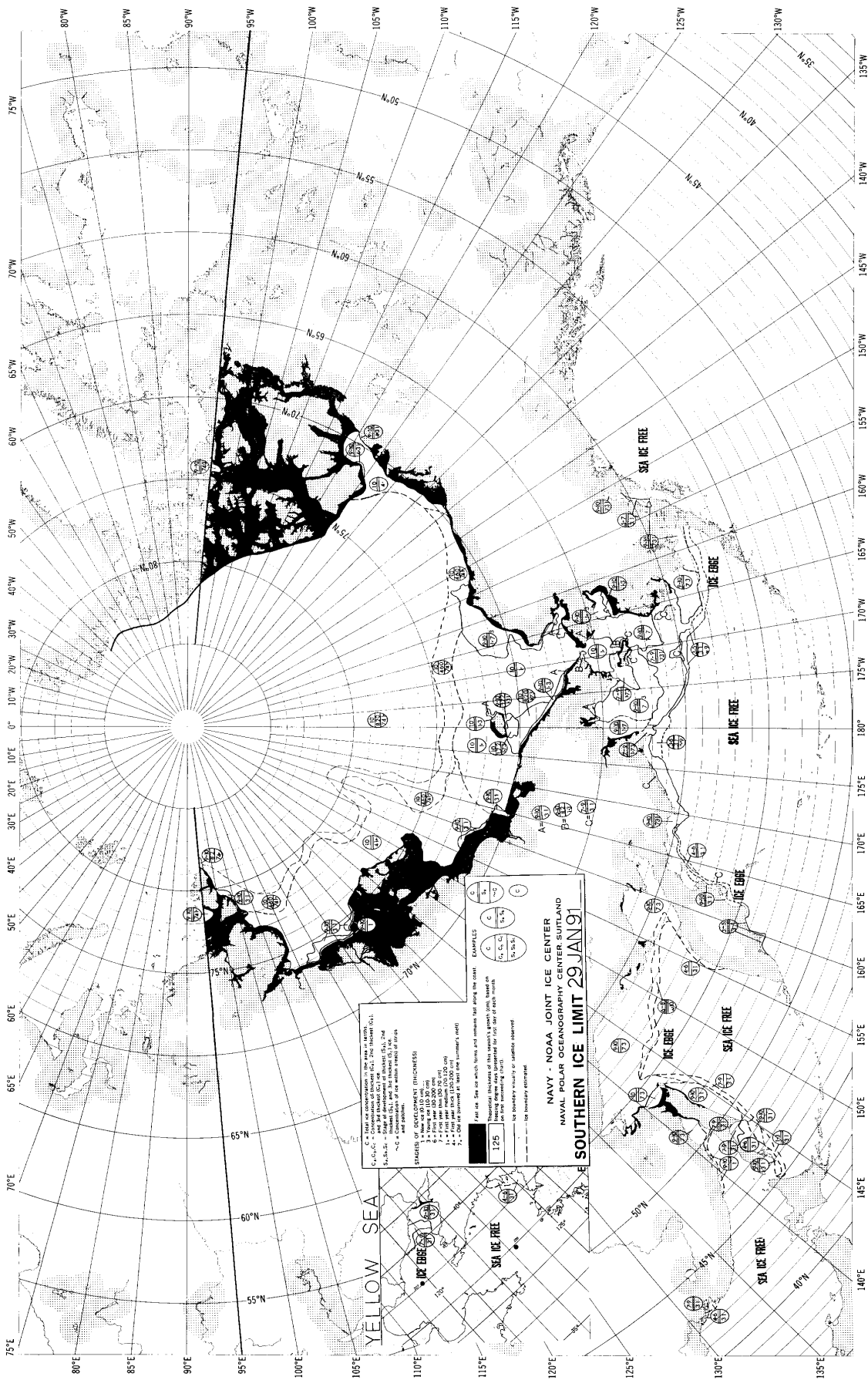
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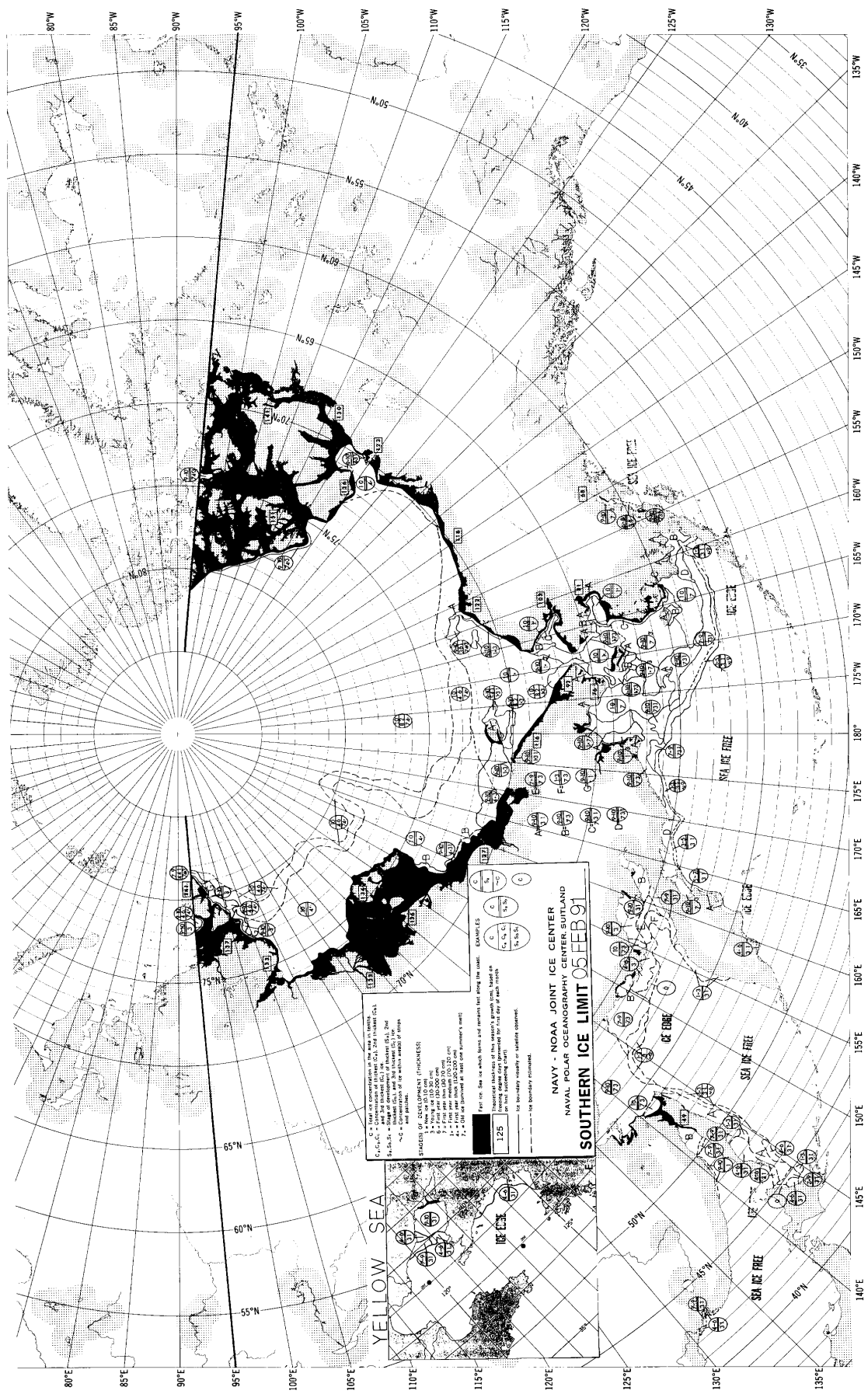
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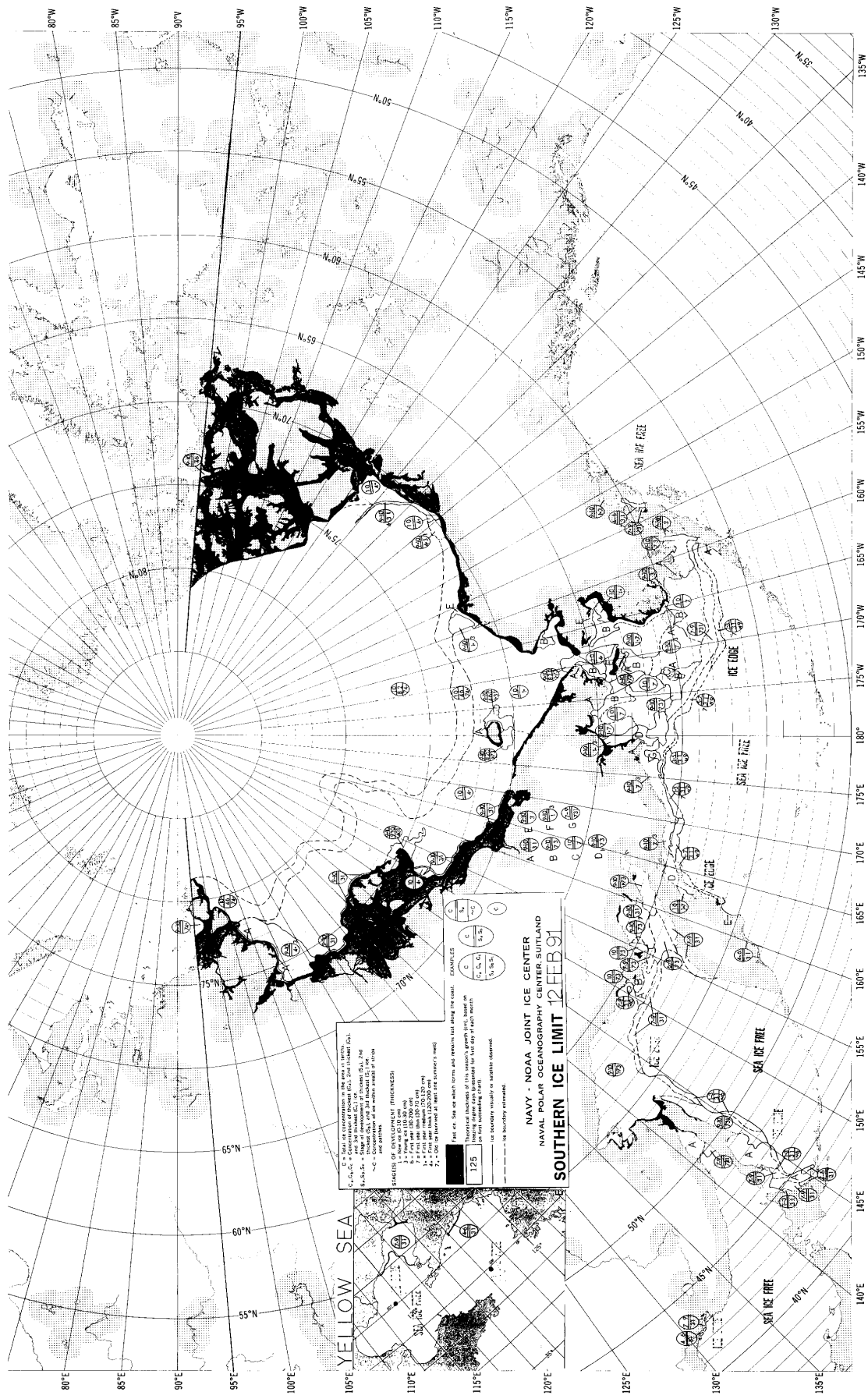


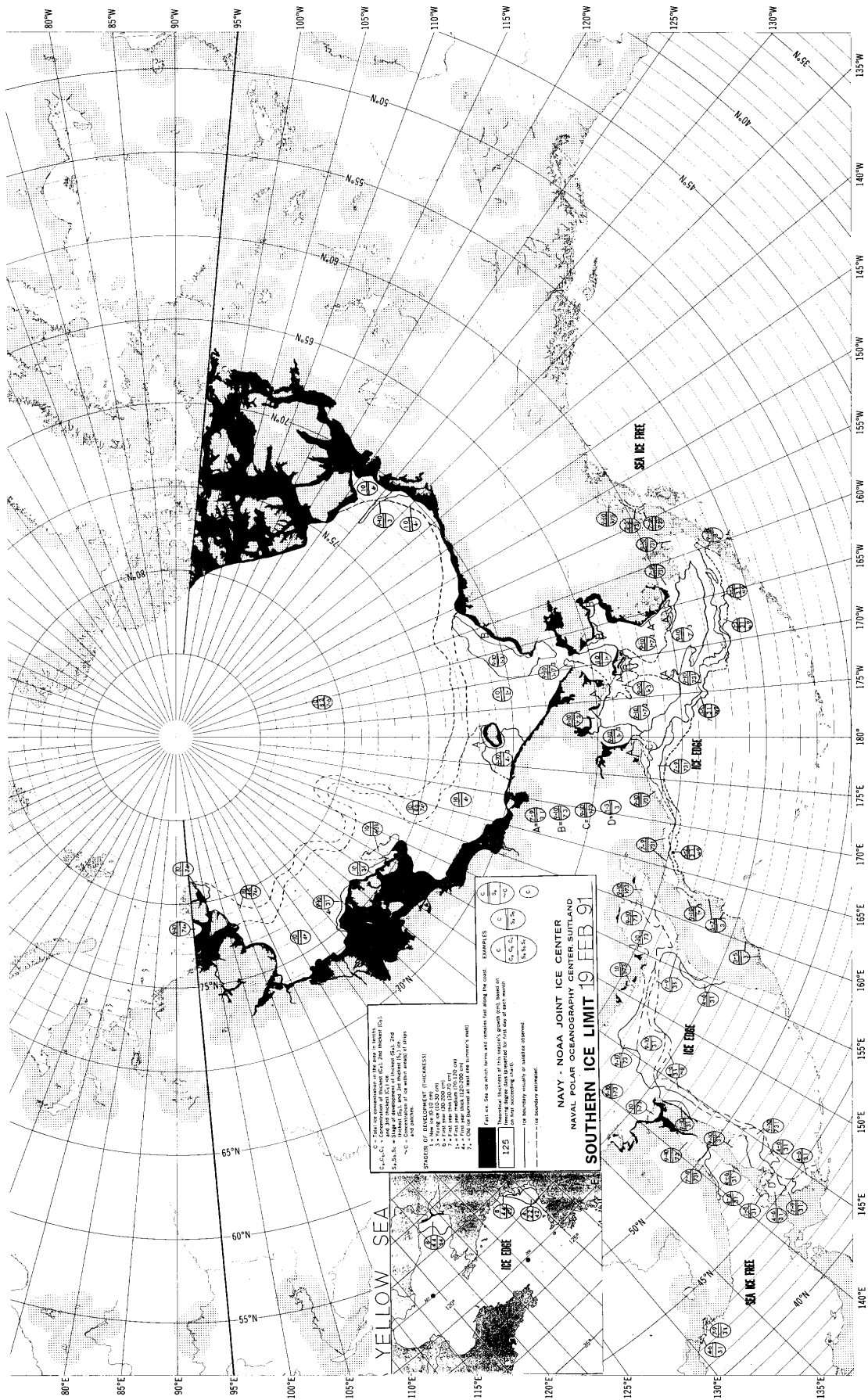


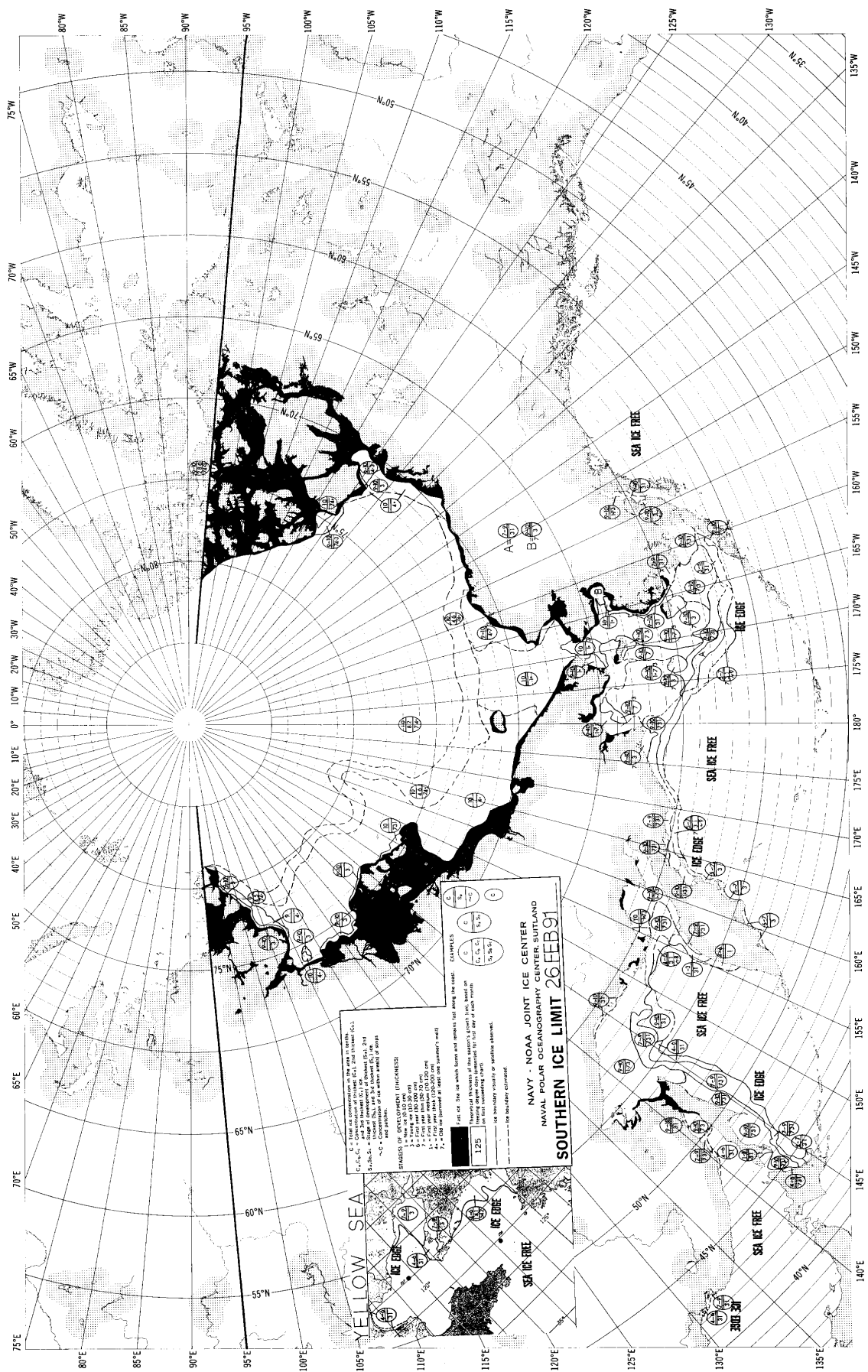


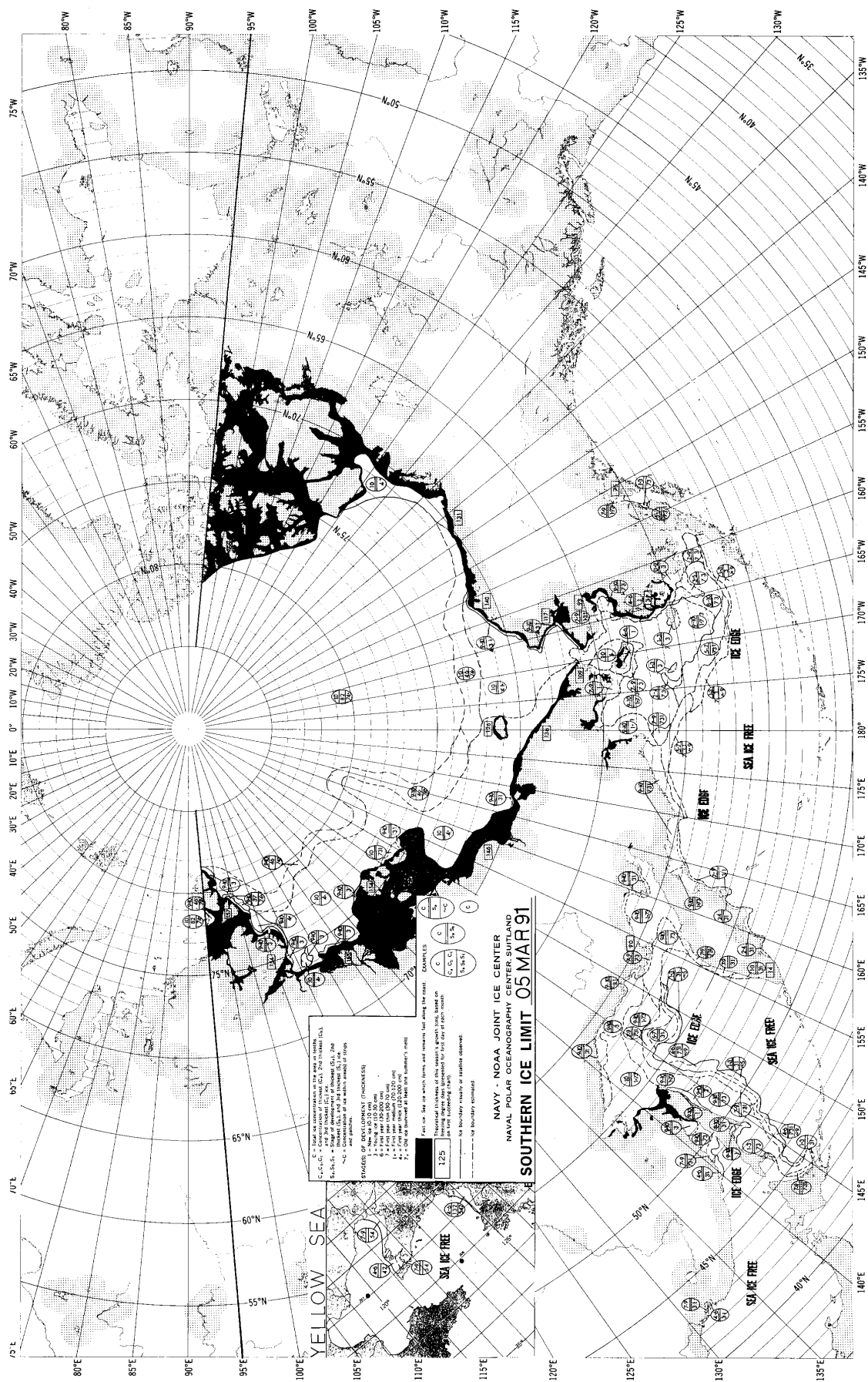


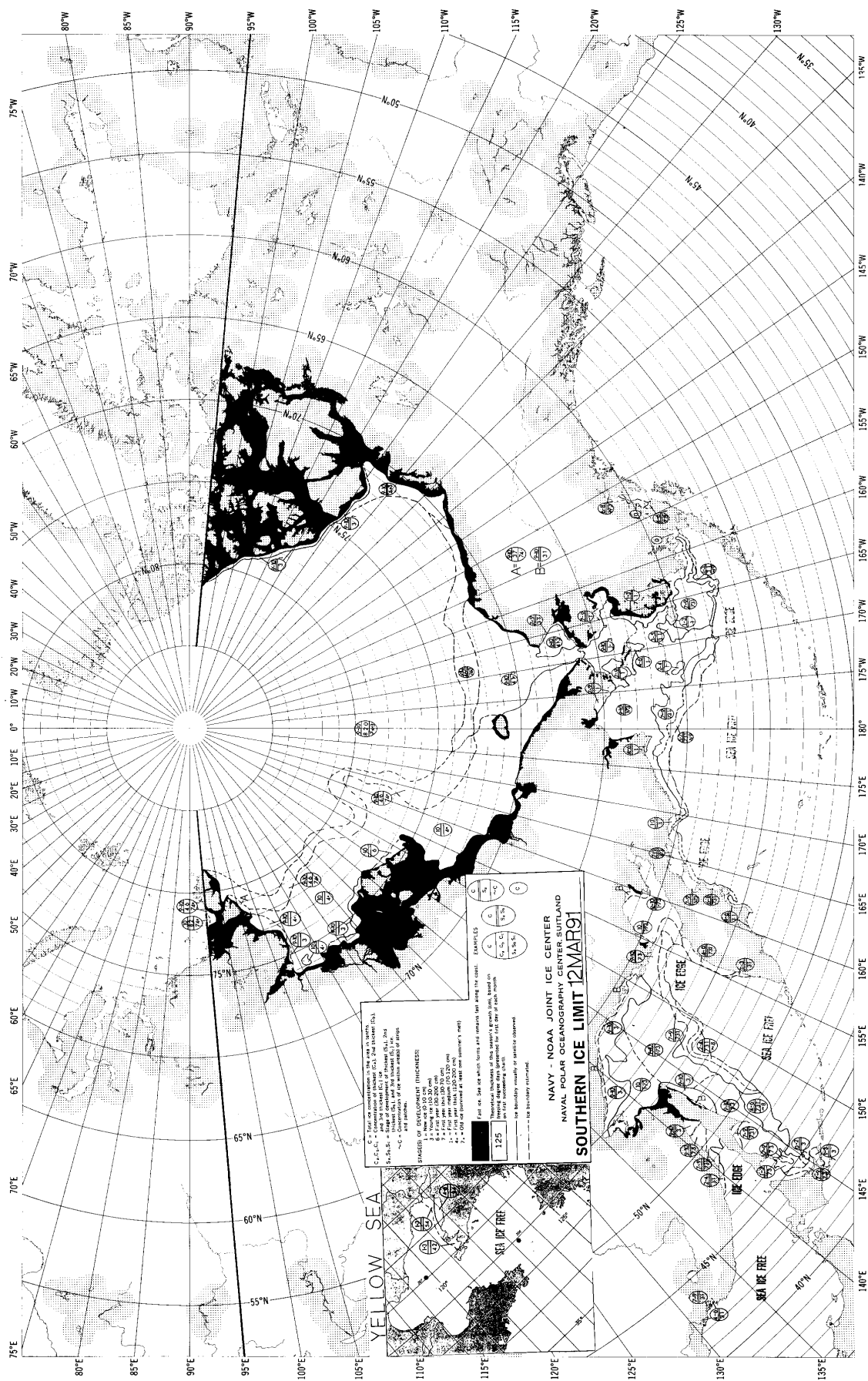


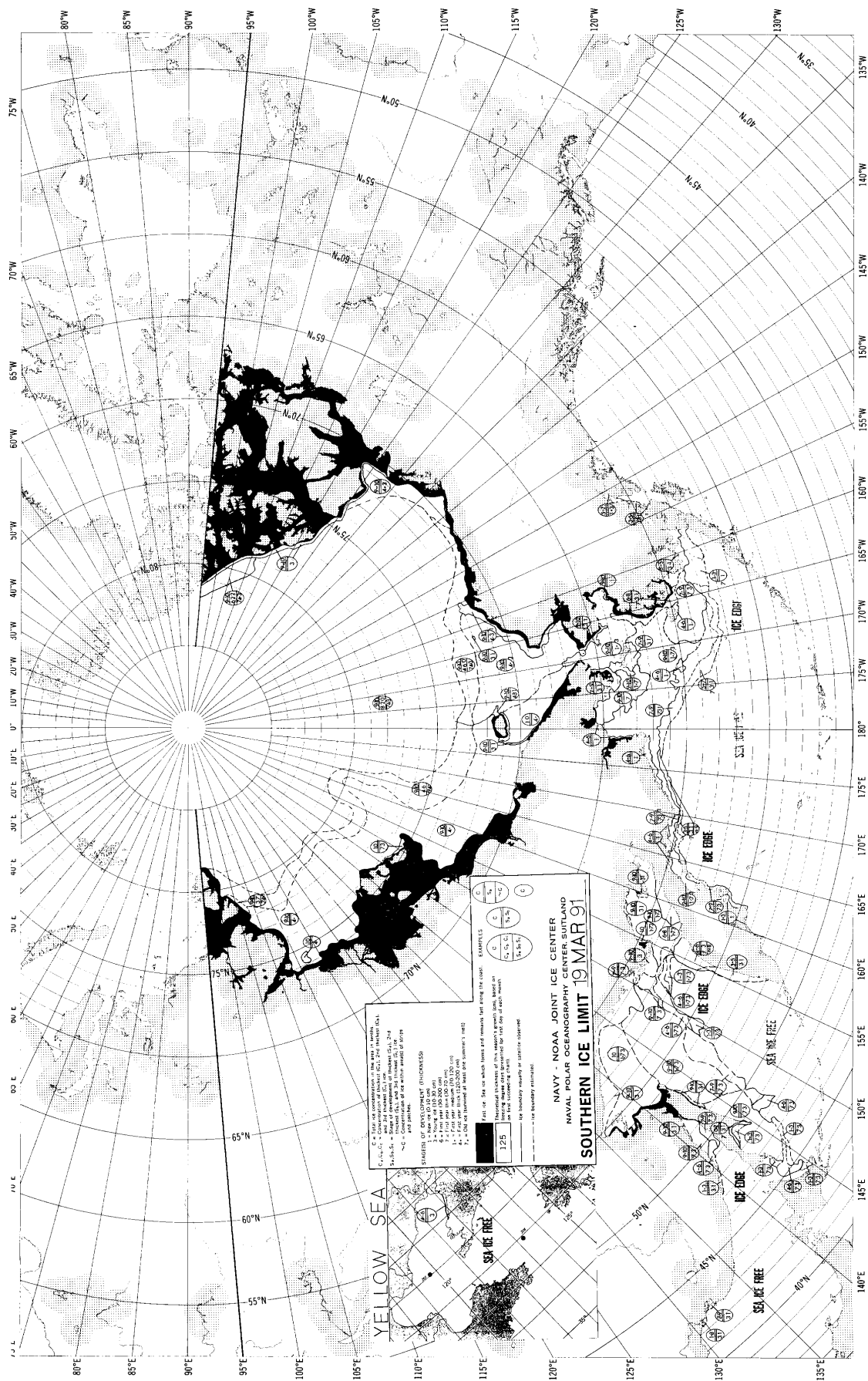


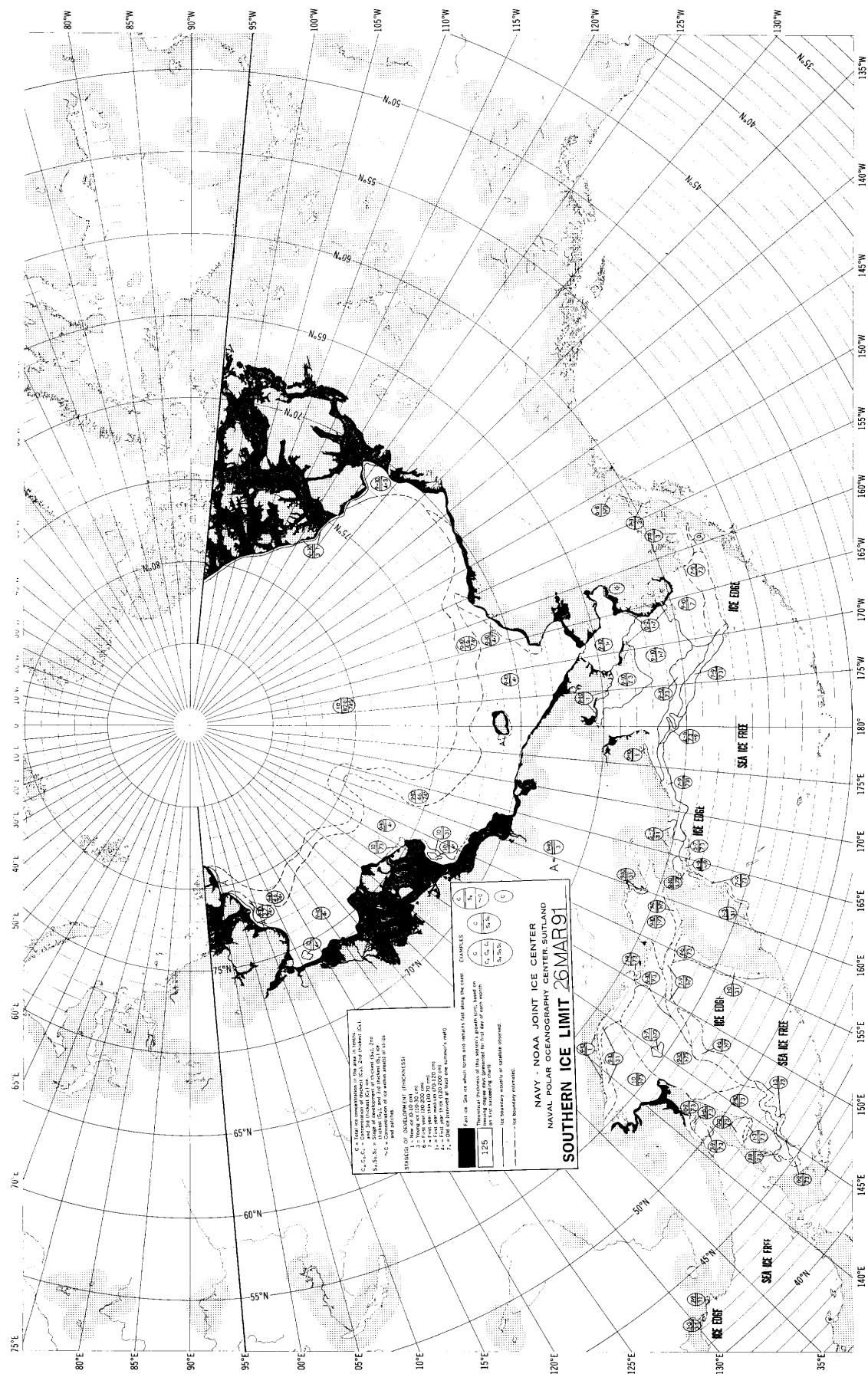


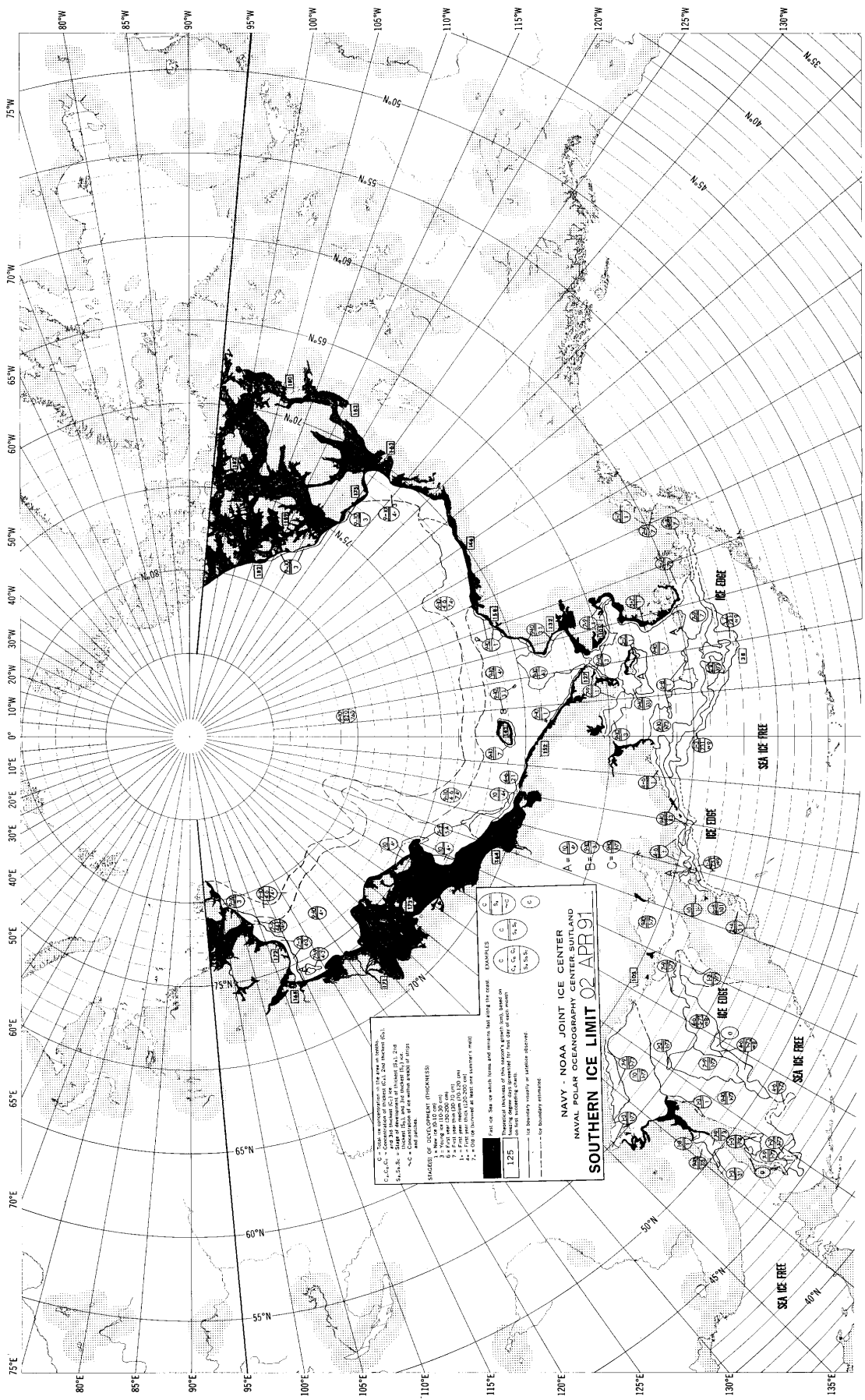










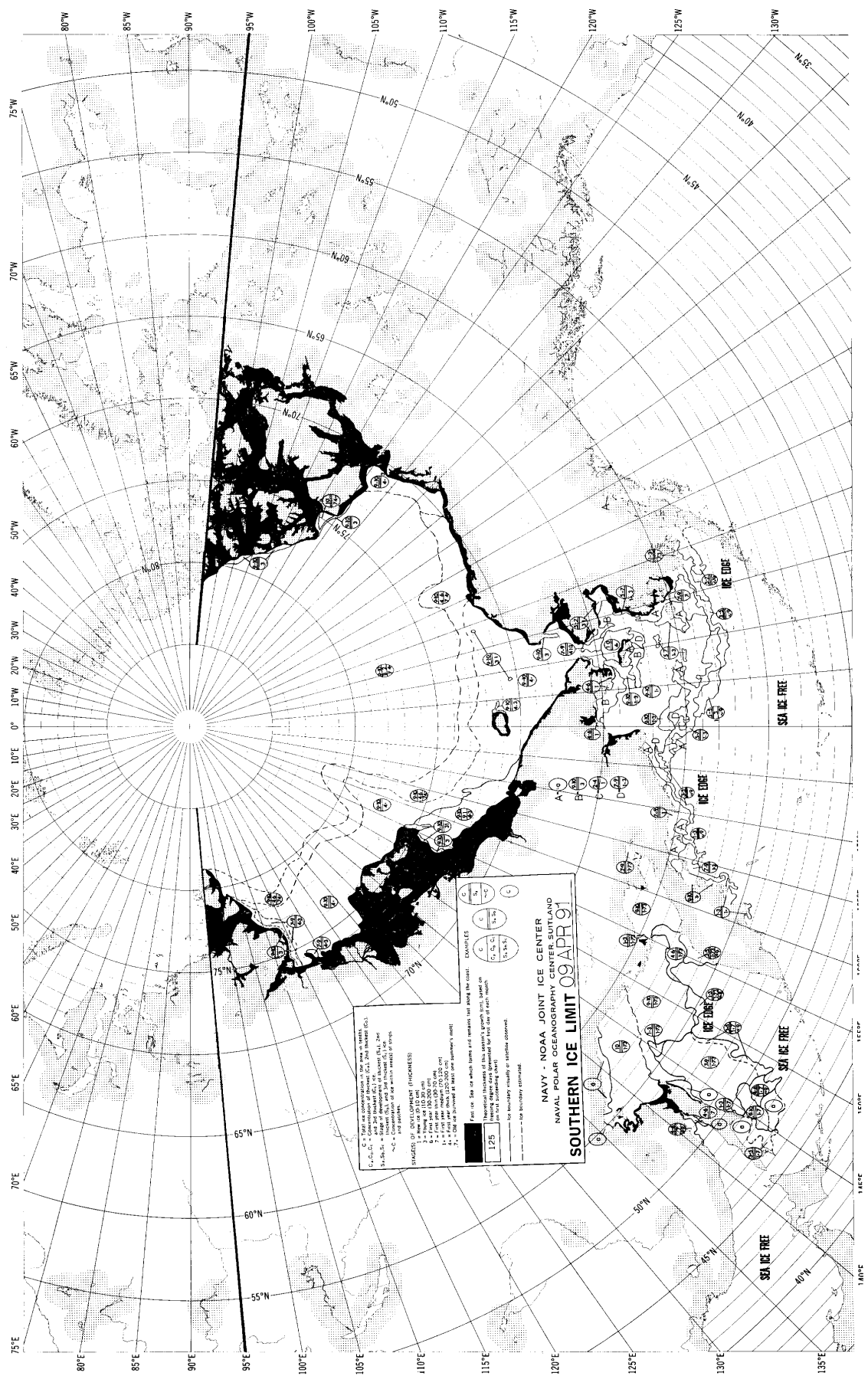


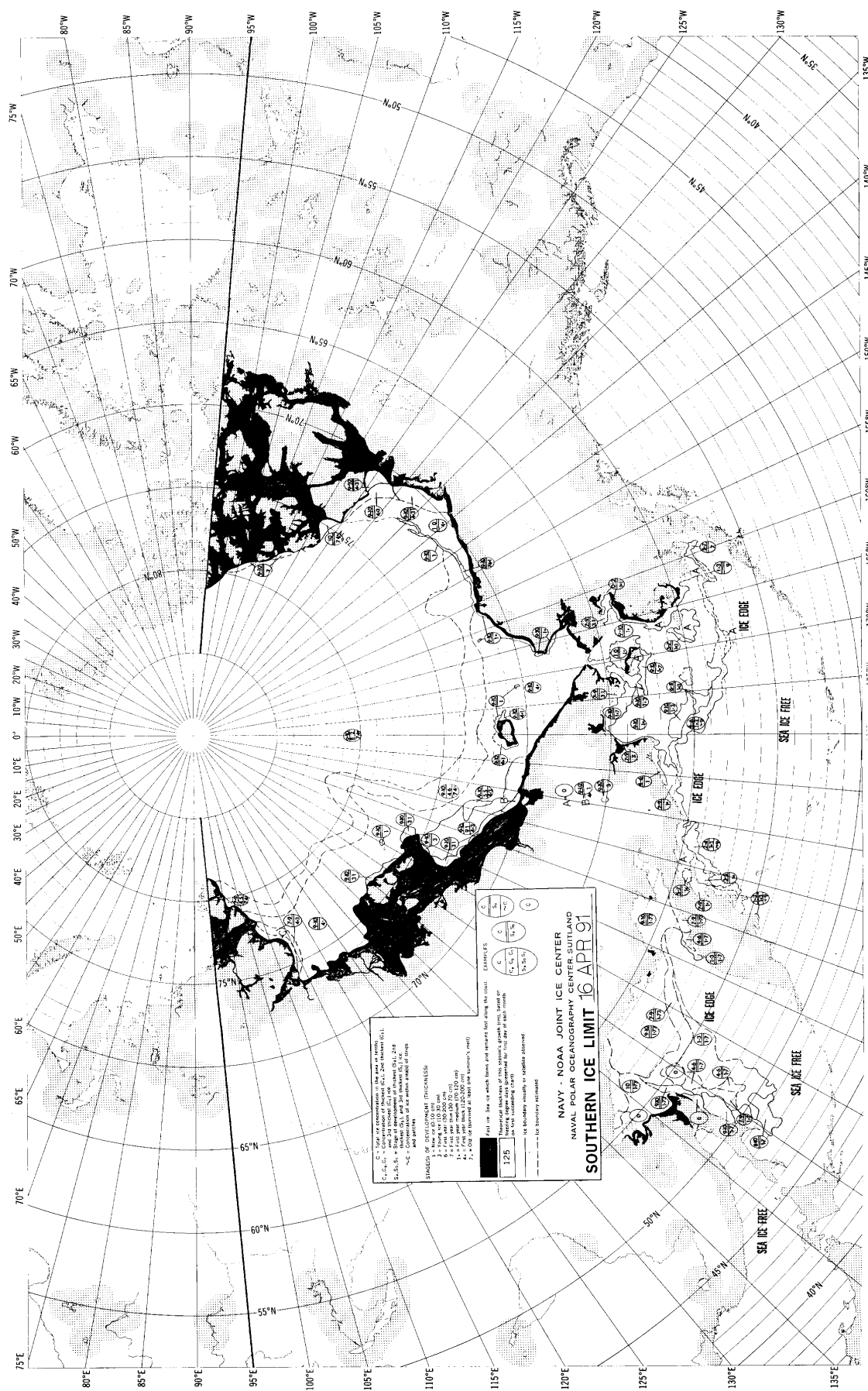
C - Total ice concentration in the area of study.
 C₁, C₂, C₃ - Concentrations of ice types I, II, and III respectively.
 S₁, S₂, S₃ - Stages of development of ice types I, II, and III respectively.
 A₁, A₂, A₃ - Concentrations of ice within sectors of 30°.
 A₁, A₂, A₃ - Concentrations of ice within sectors of 30°.

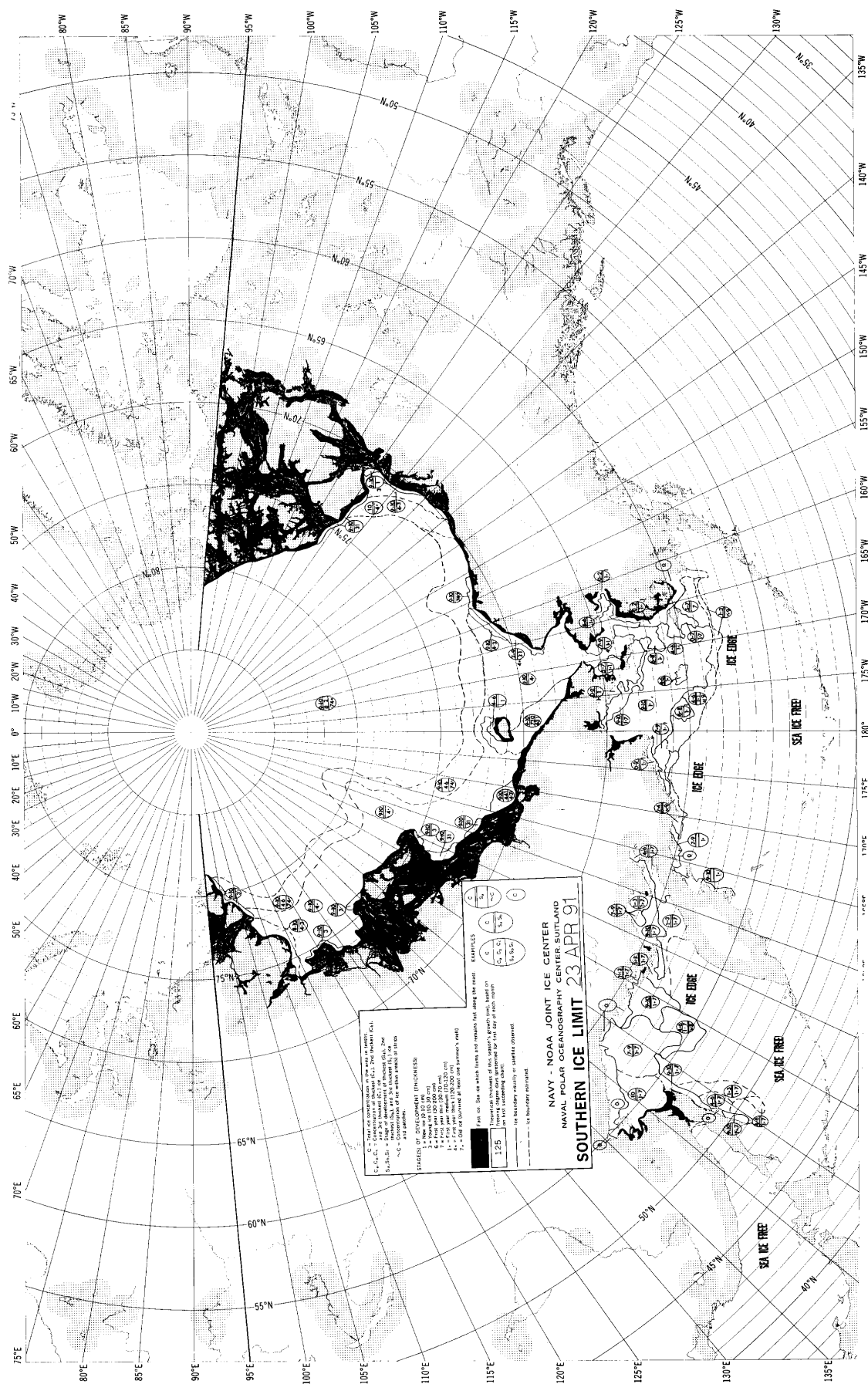
SIZES OF ICE CONCENTRATIONS (THICKNESS)
 1 - None or 0-10 cm
 2 - 10-20 cm
 3 - 20-30 cm
 4 - 30-40 cm
 5 - 40-50 cm
 6 - 50-60 cm
 7 - 60-70 cm
 8 - 70-80 cm
 9 - 80-90 cm
 10 - 90-100 cm
 11 - 100-110 cm
 12 - 110-120 cm
 13 - 120-130 cm
 14 - 130-140 cm
 15 - 140-150 cm
 16 - 150-160 cm
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 82 - 810-820 cm
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 87 - 860-870 cm
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 99 - 980-990 cm
 100 - 990-1000 cm

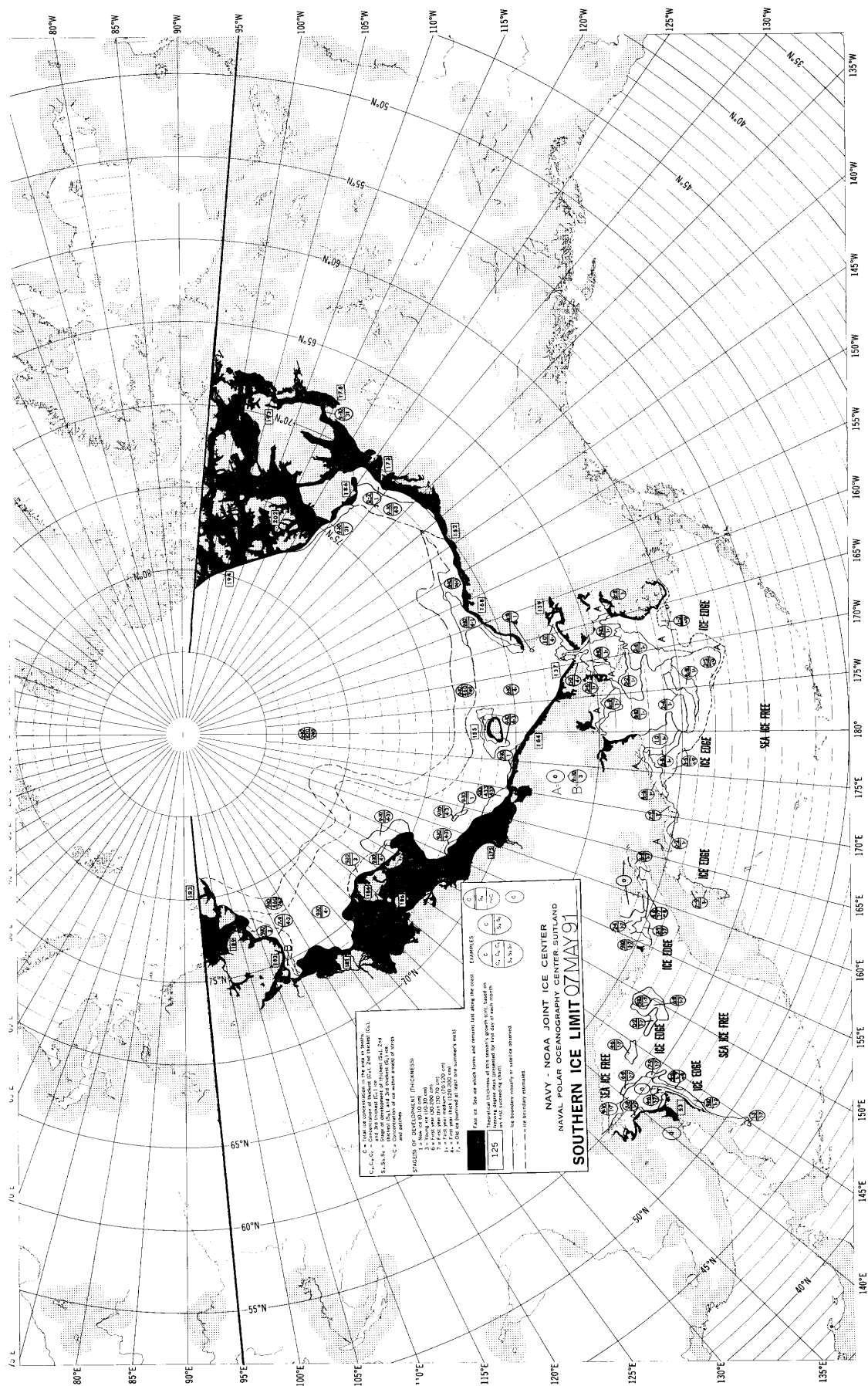
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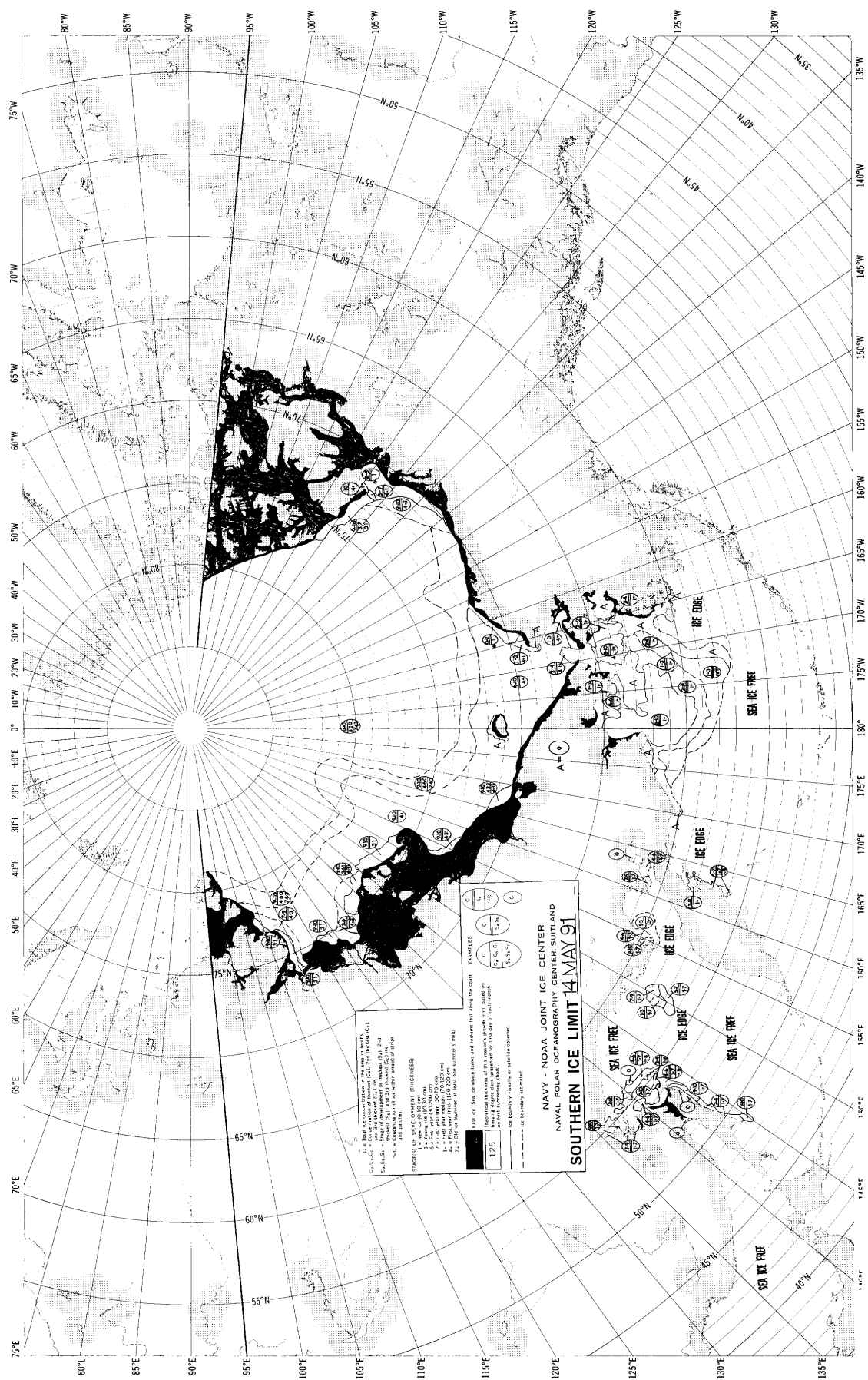
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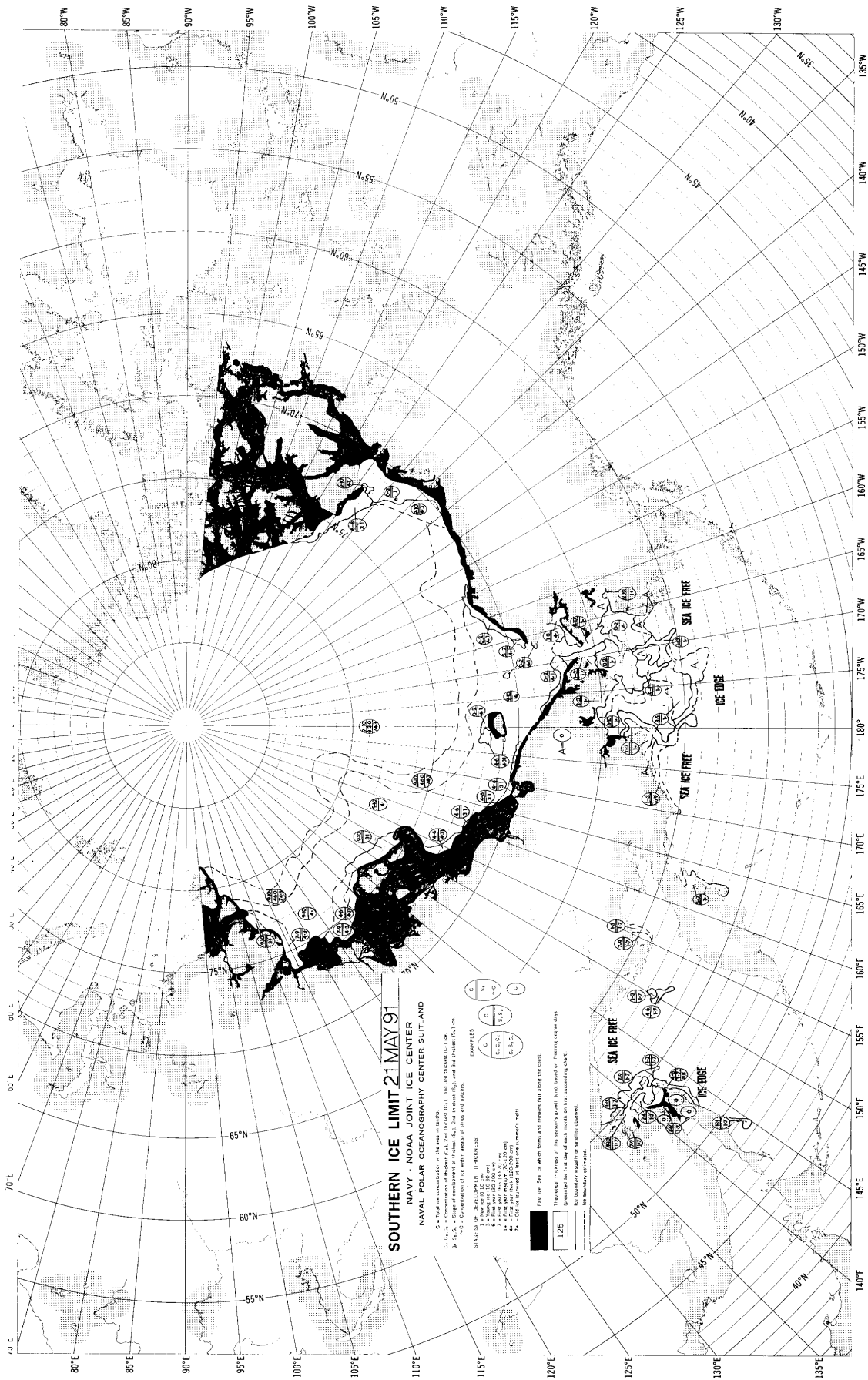


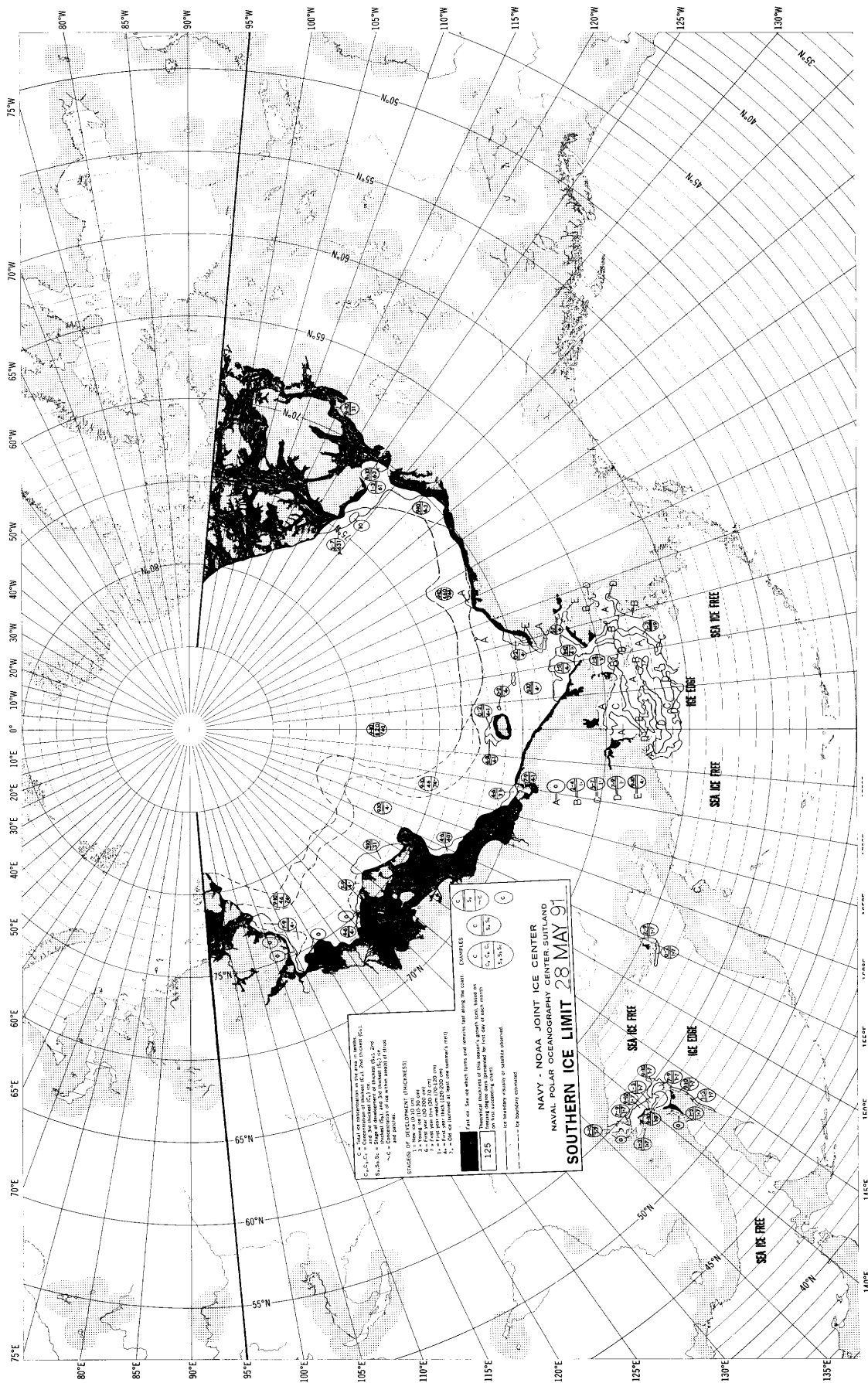


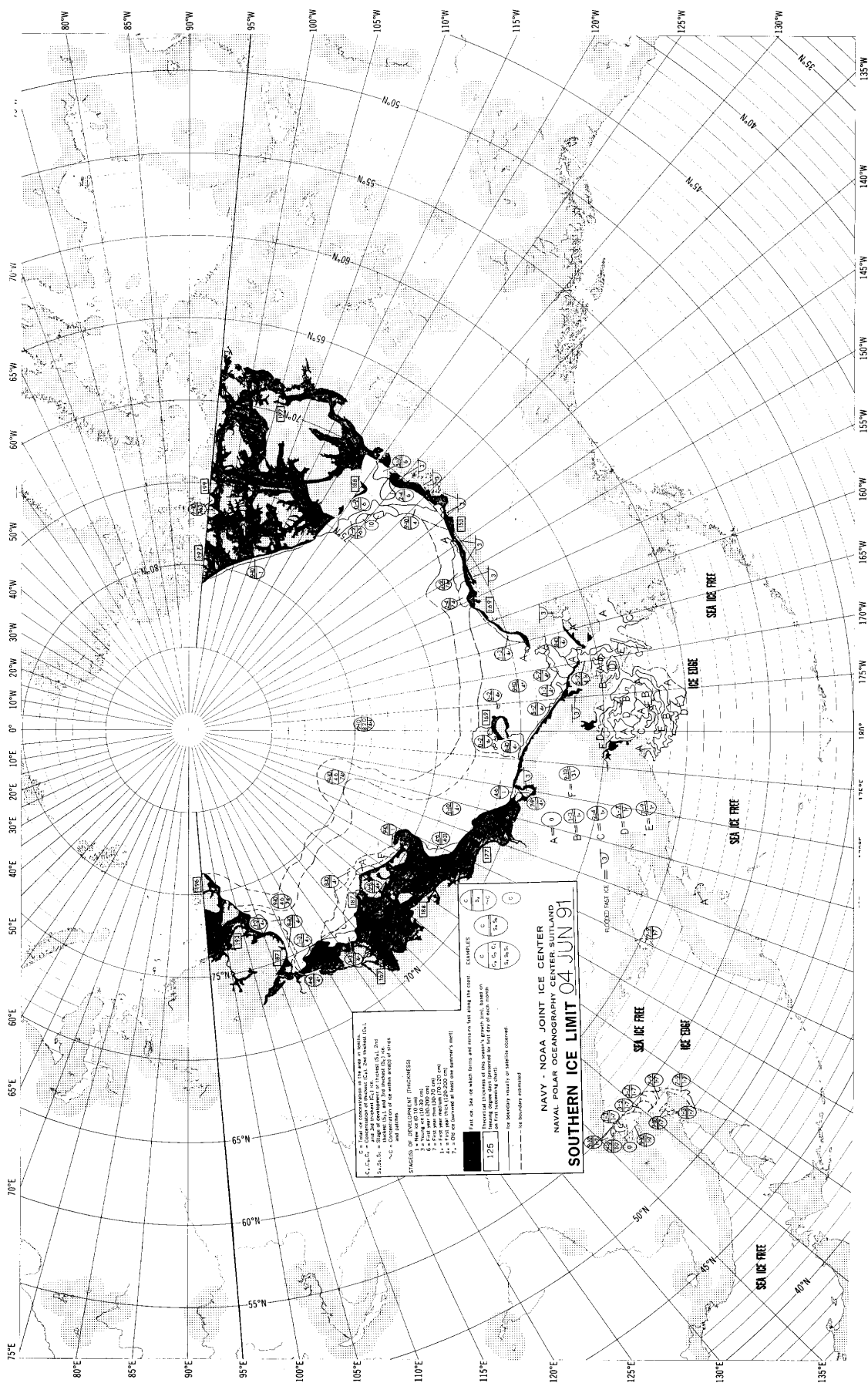


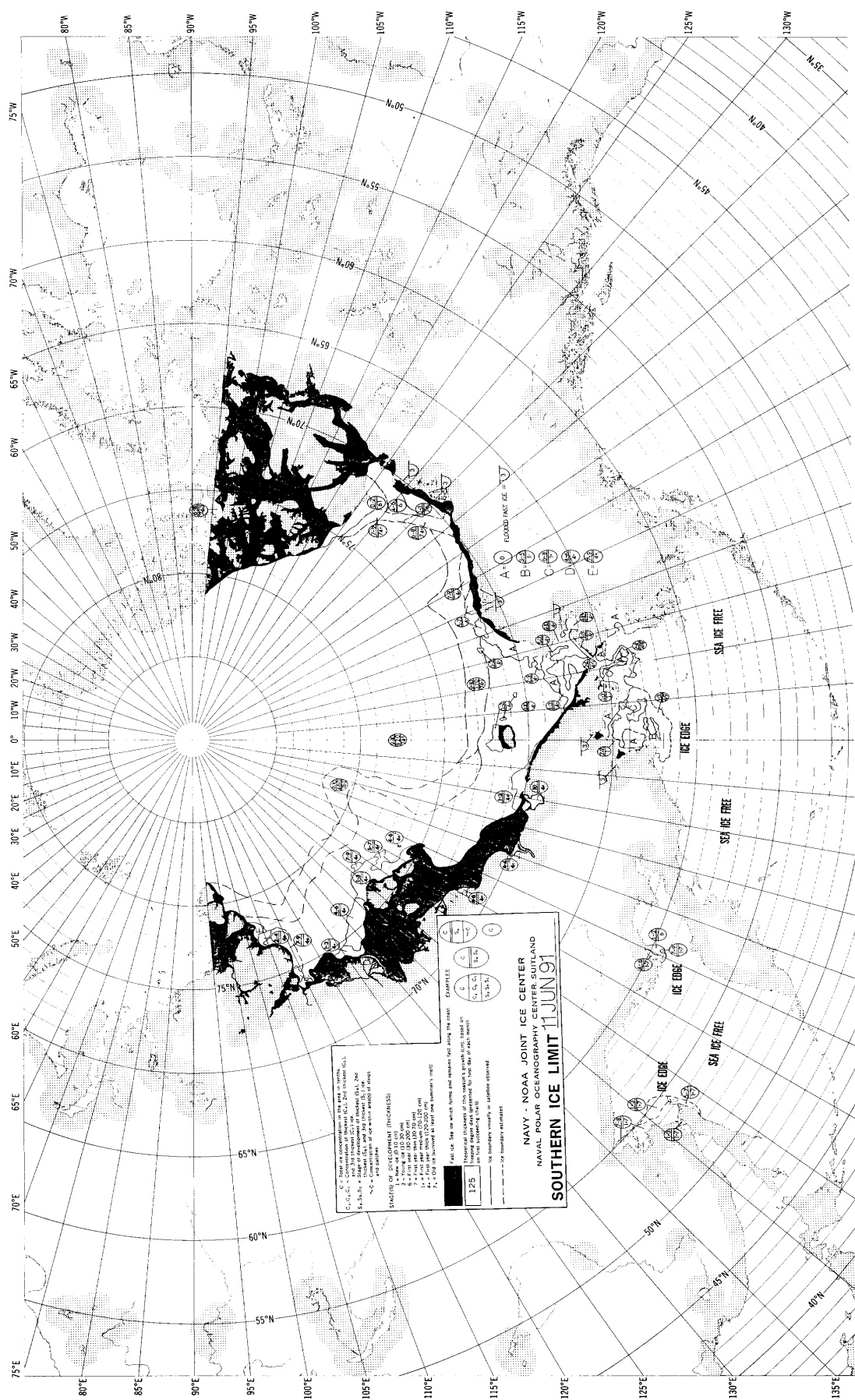


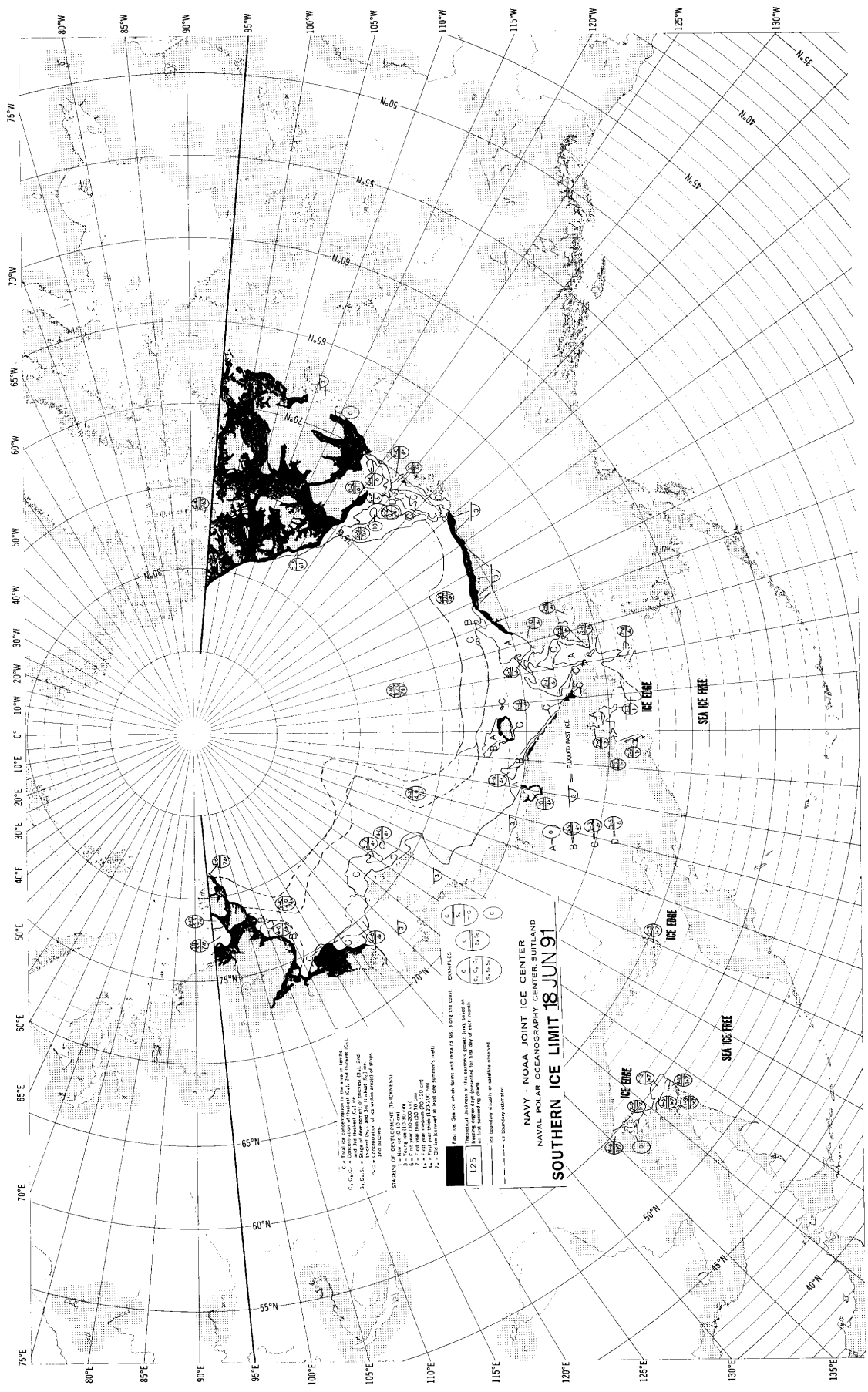


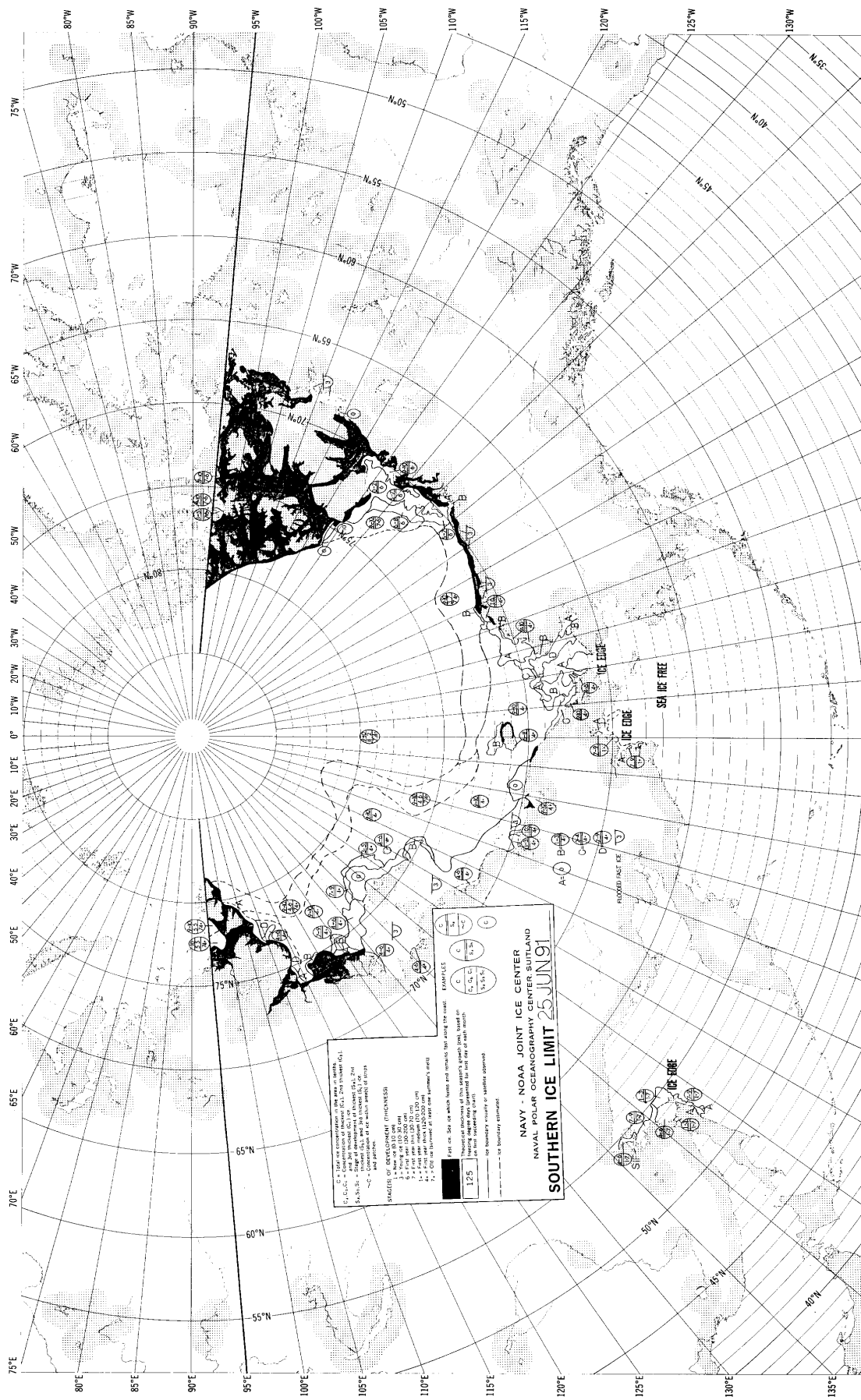


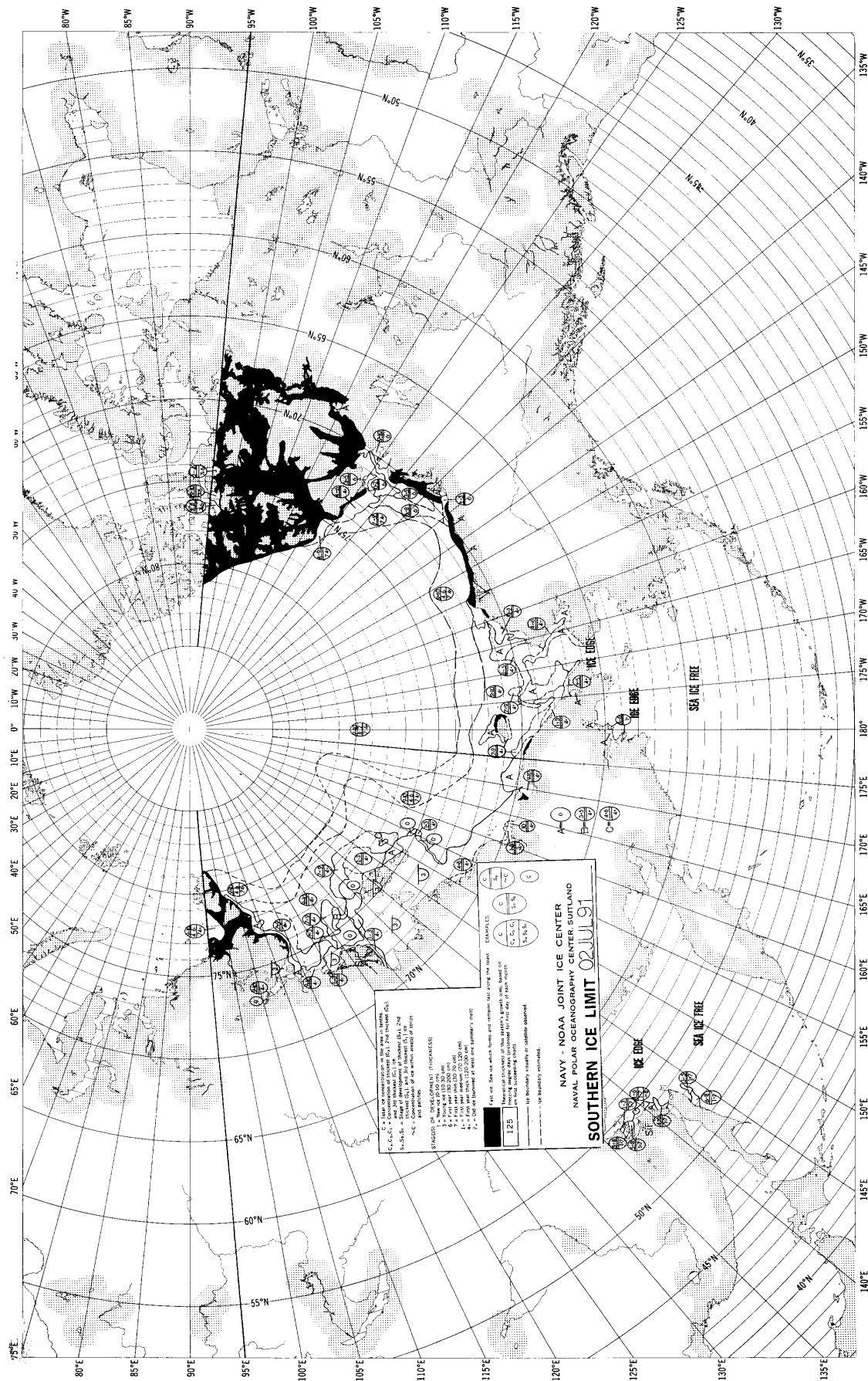


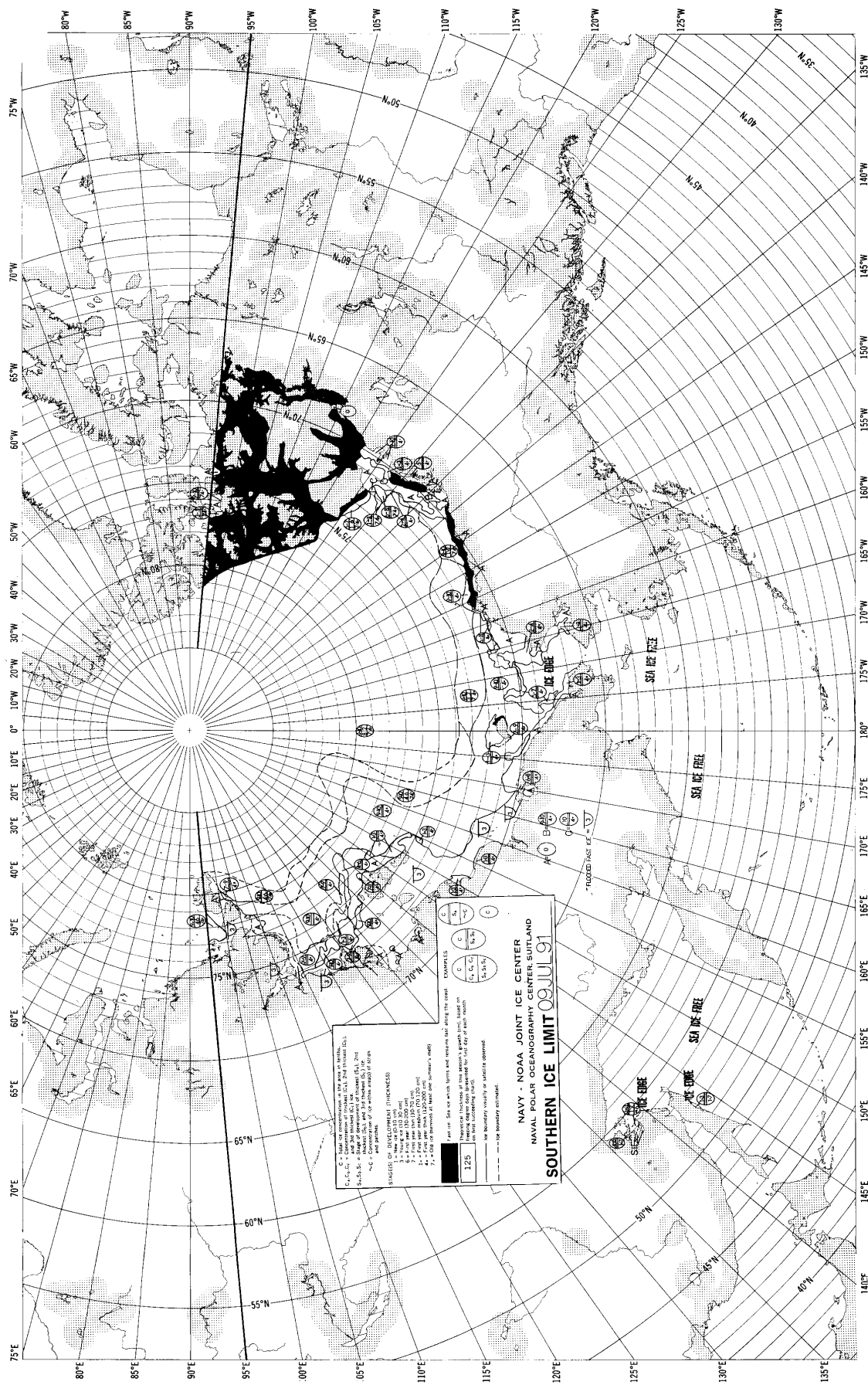


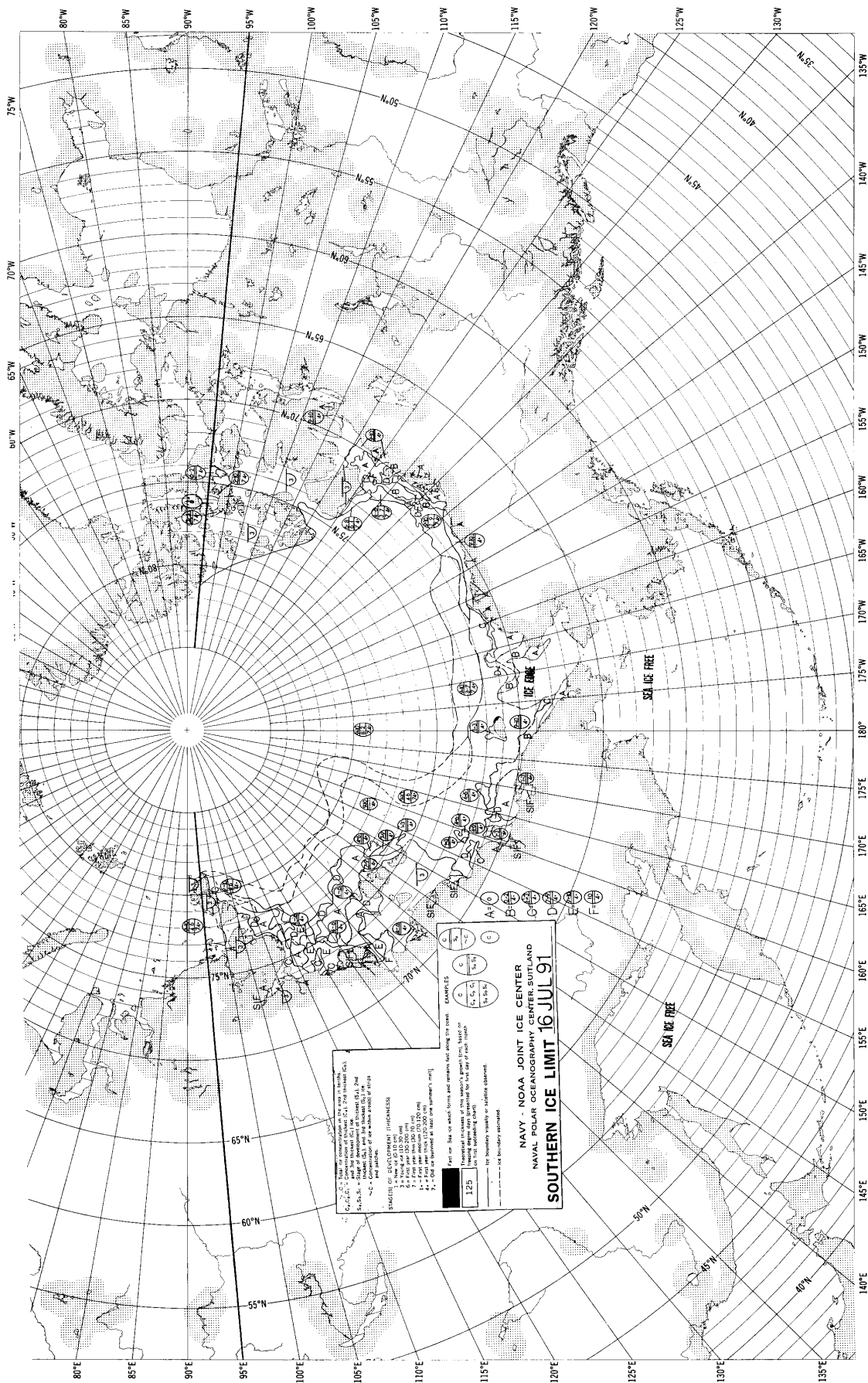


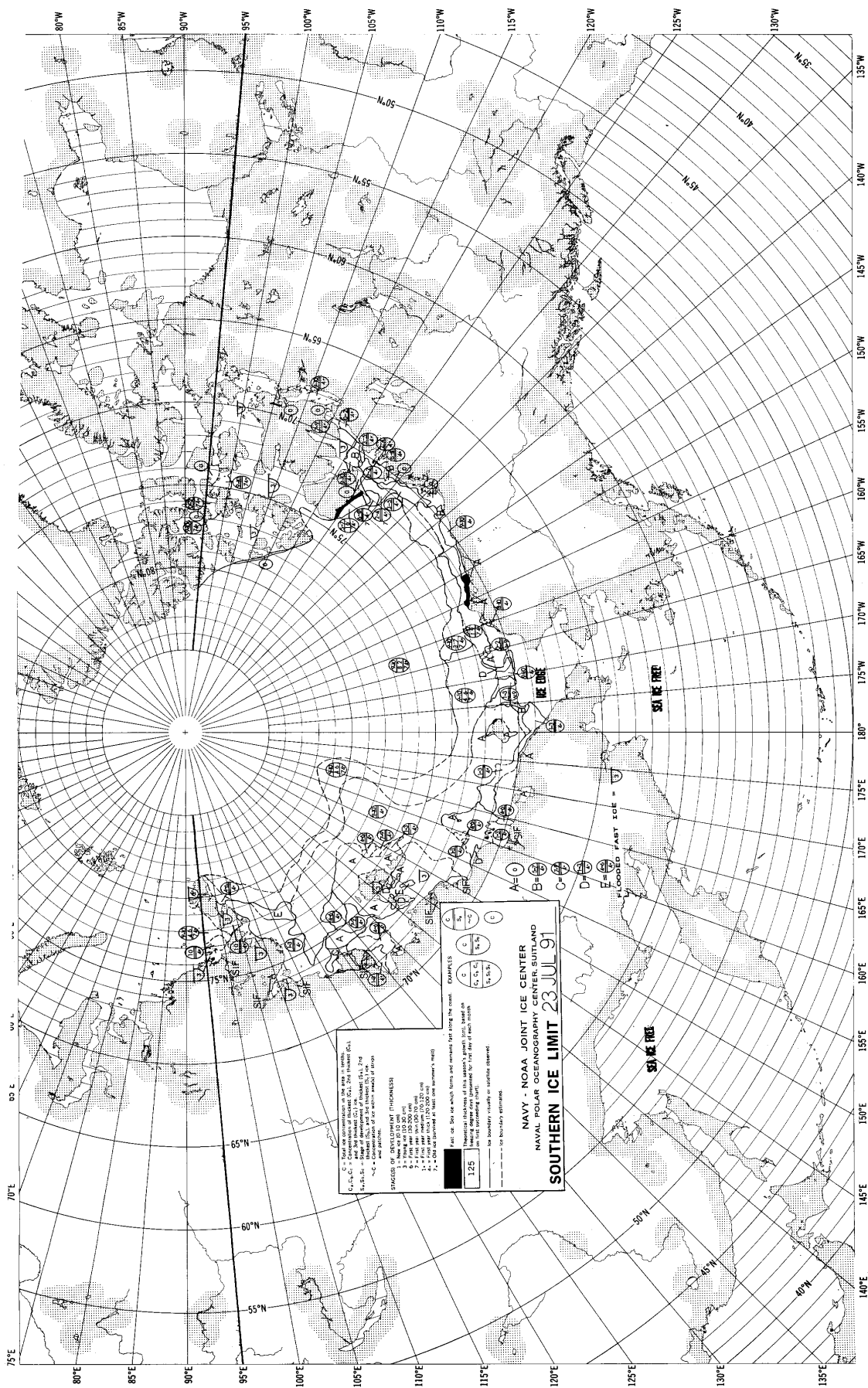


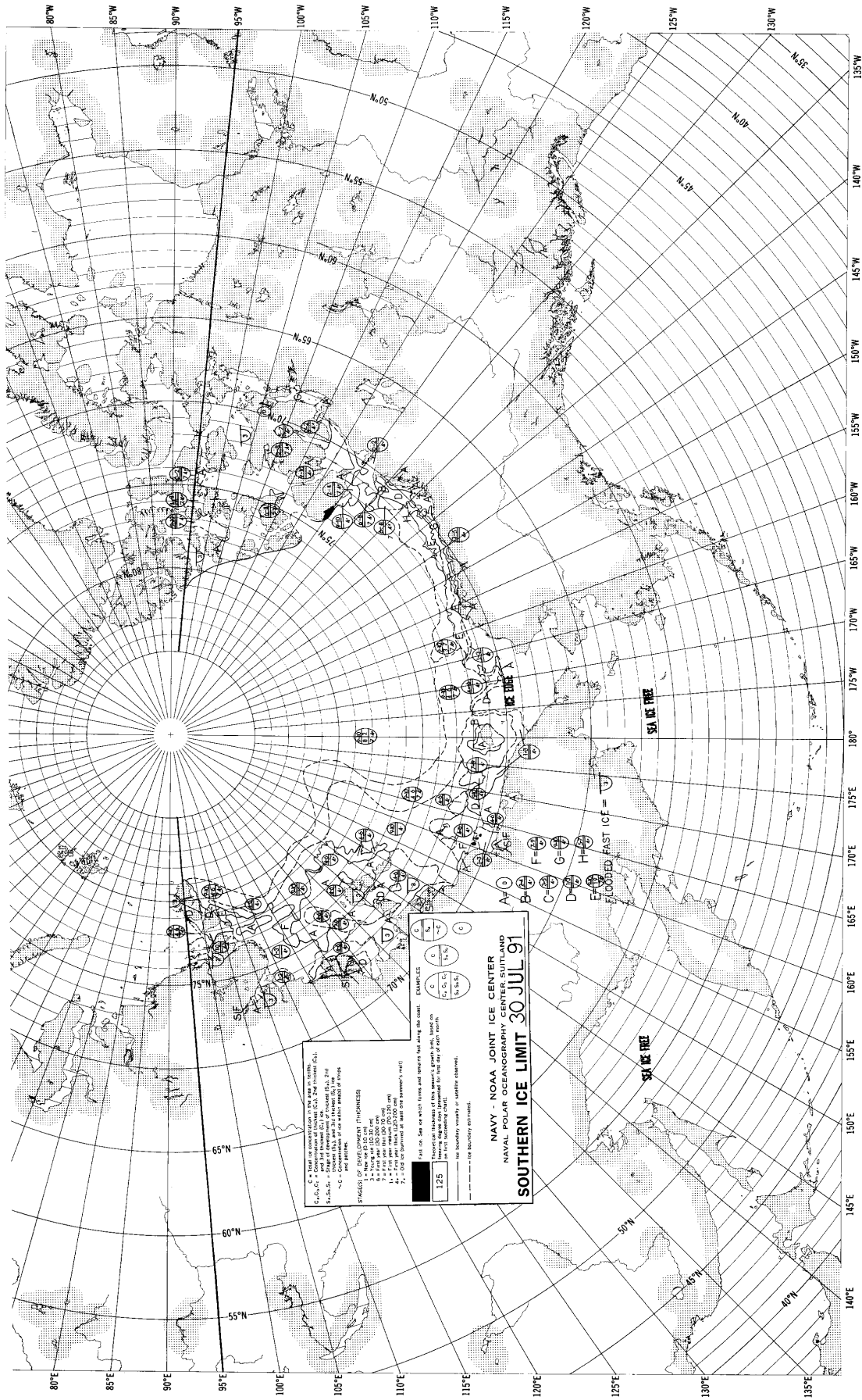


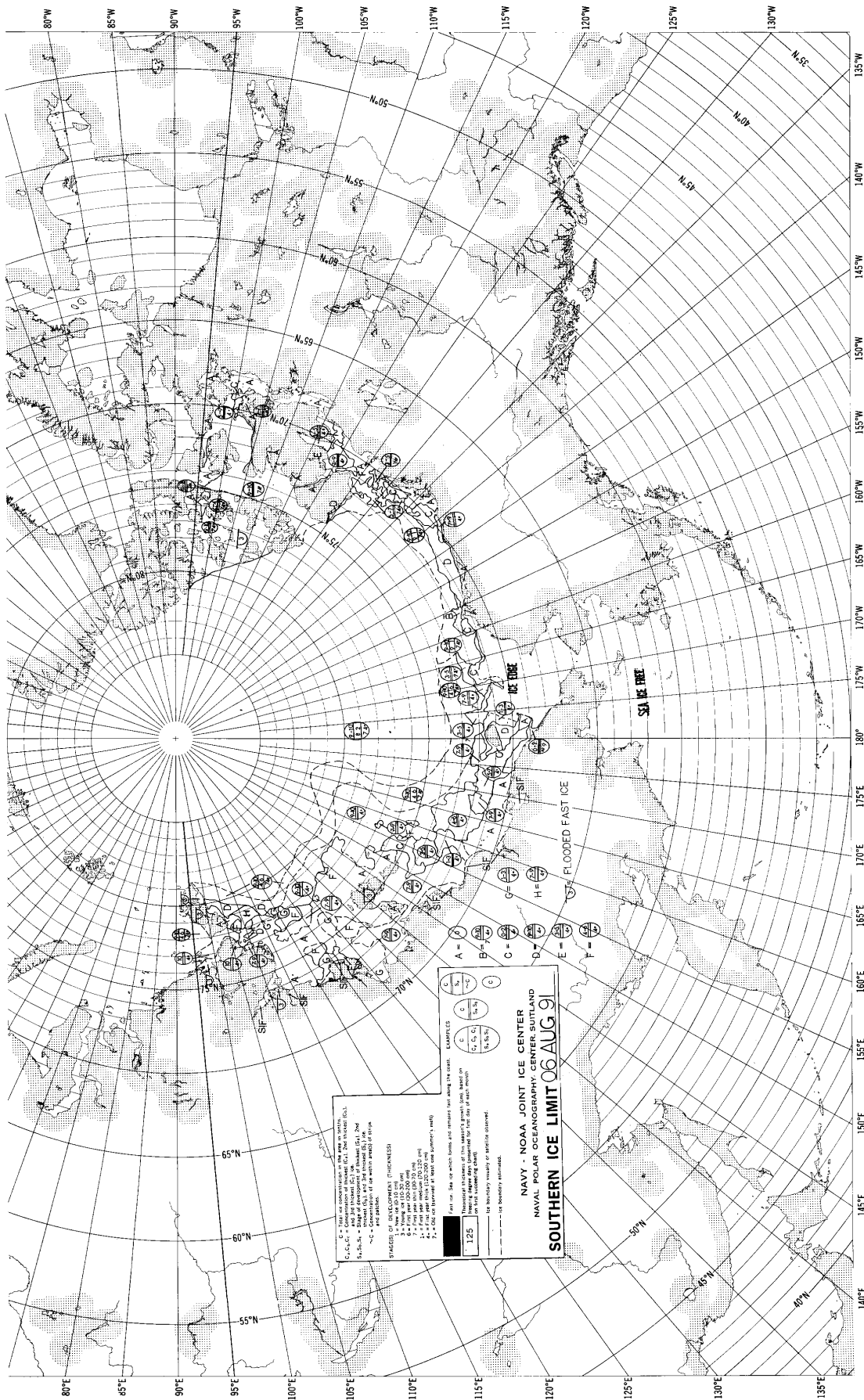


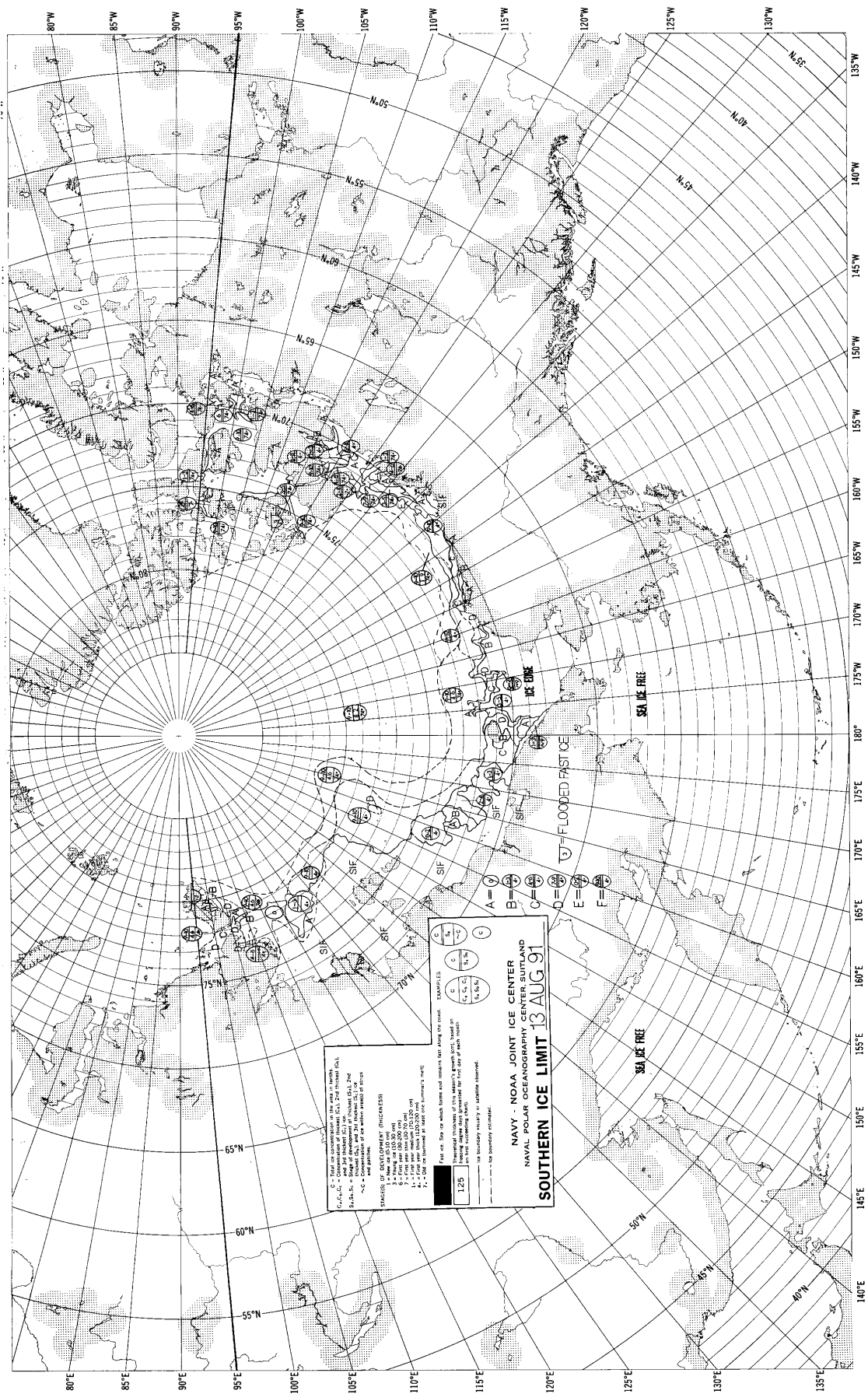


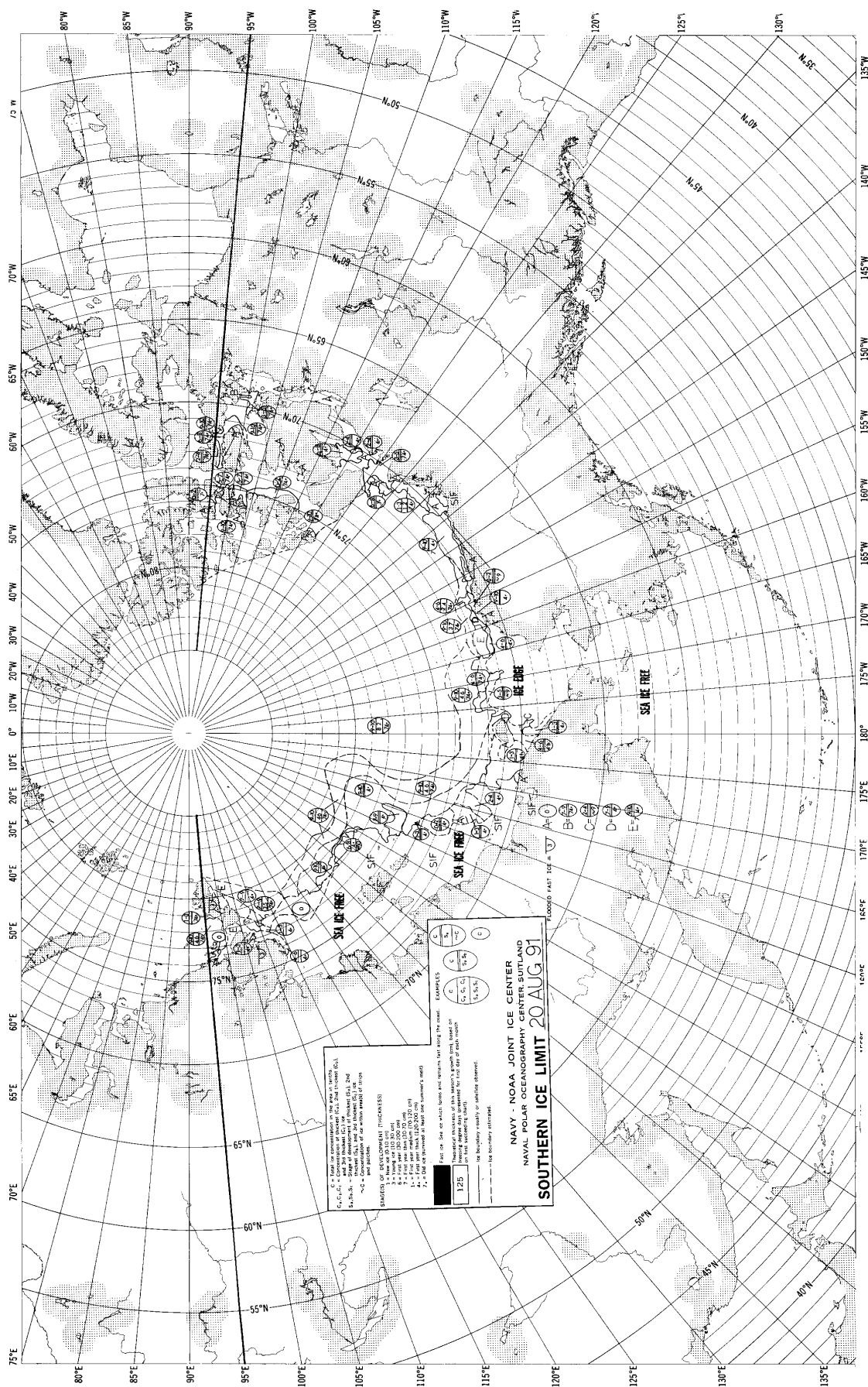


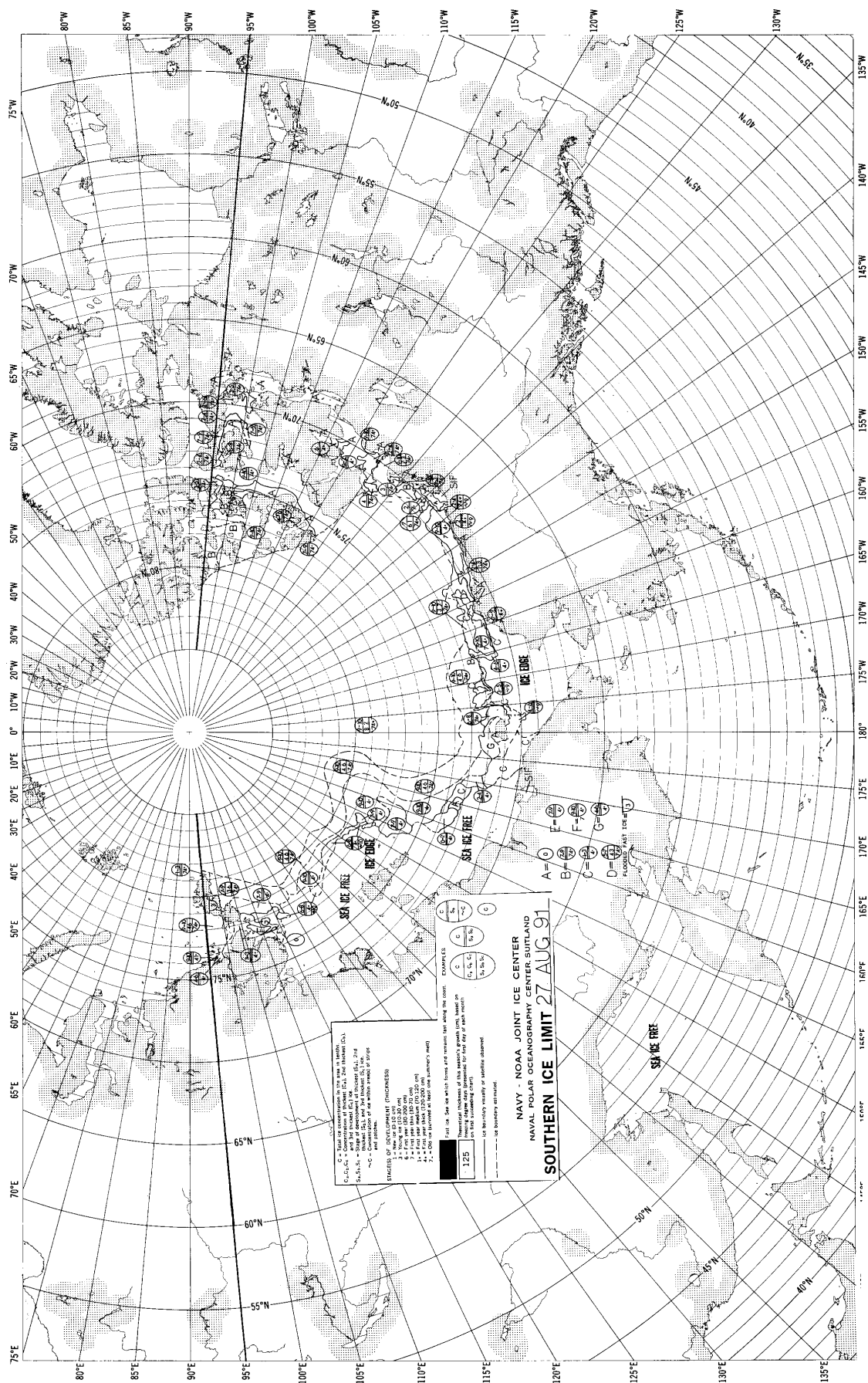


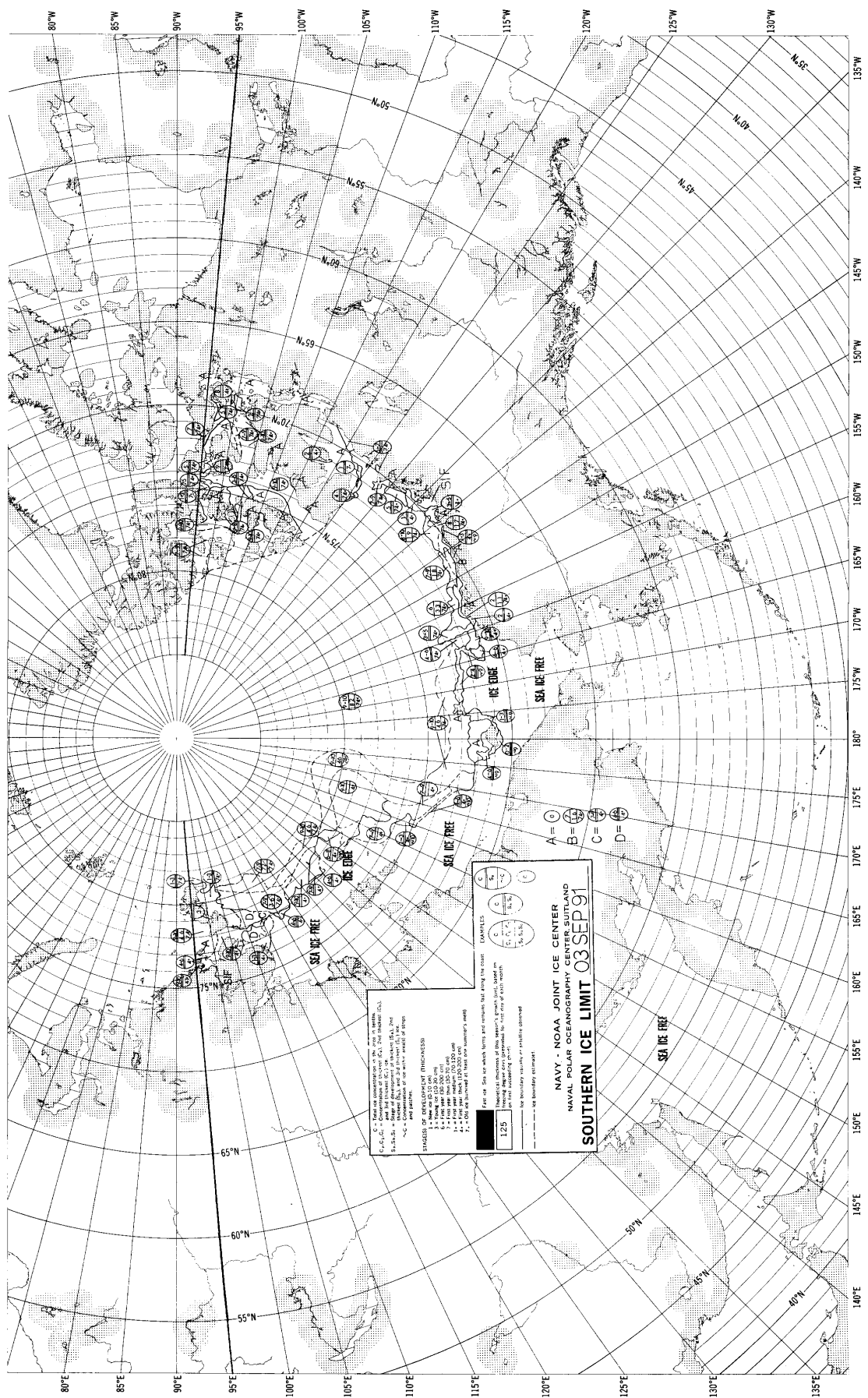


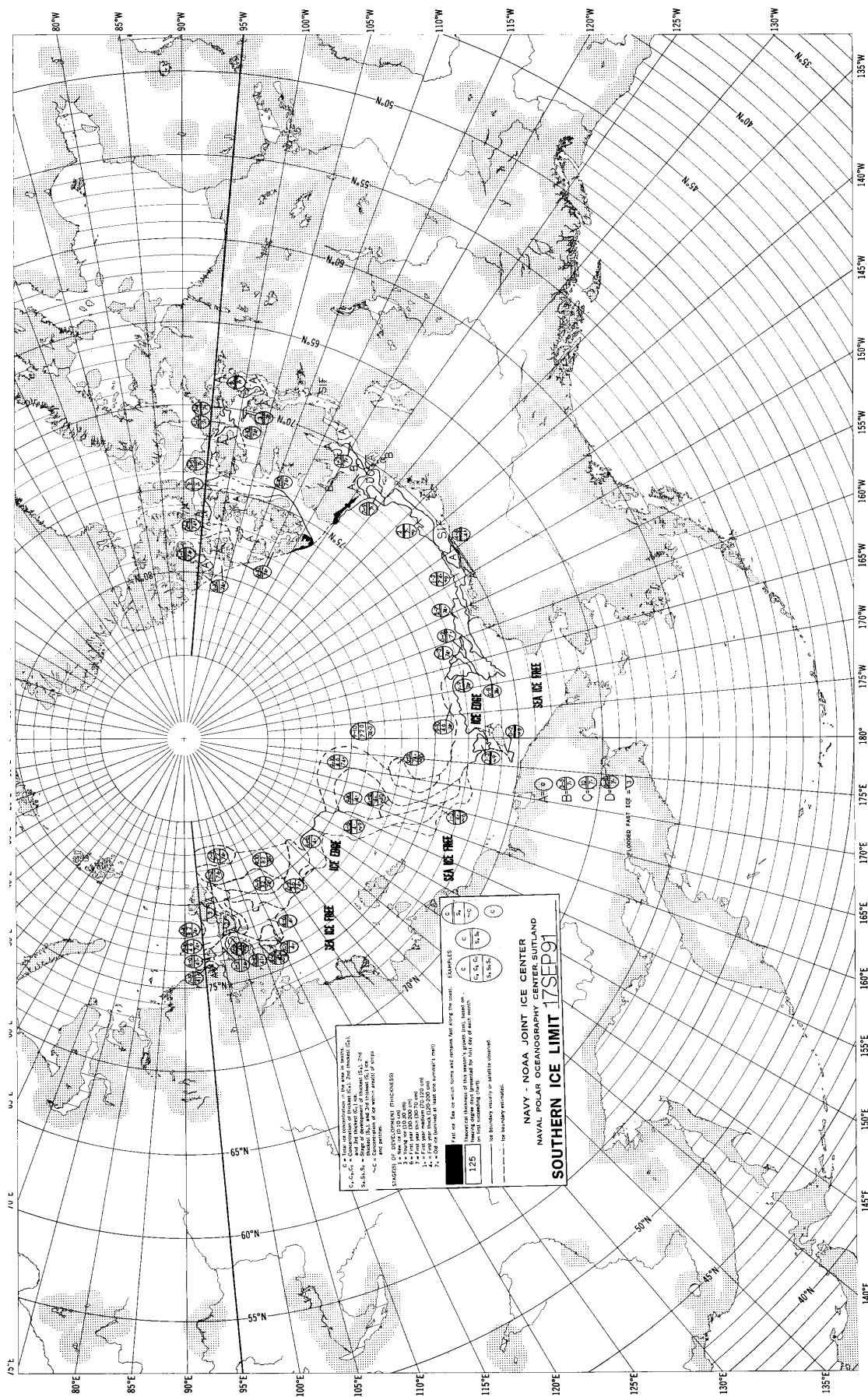


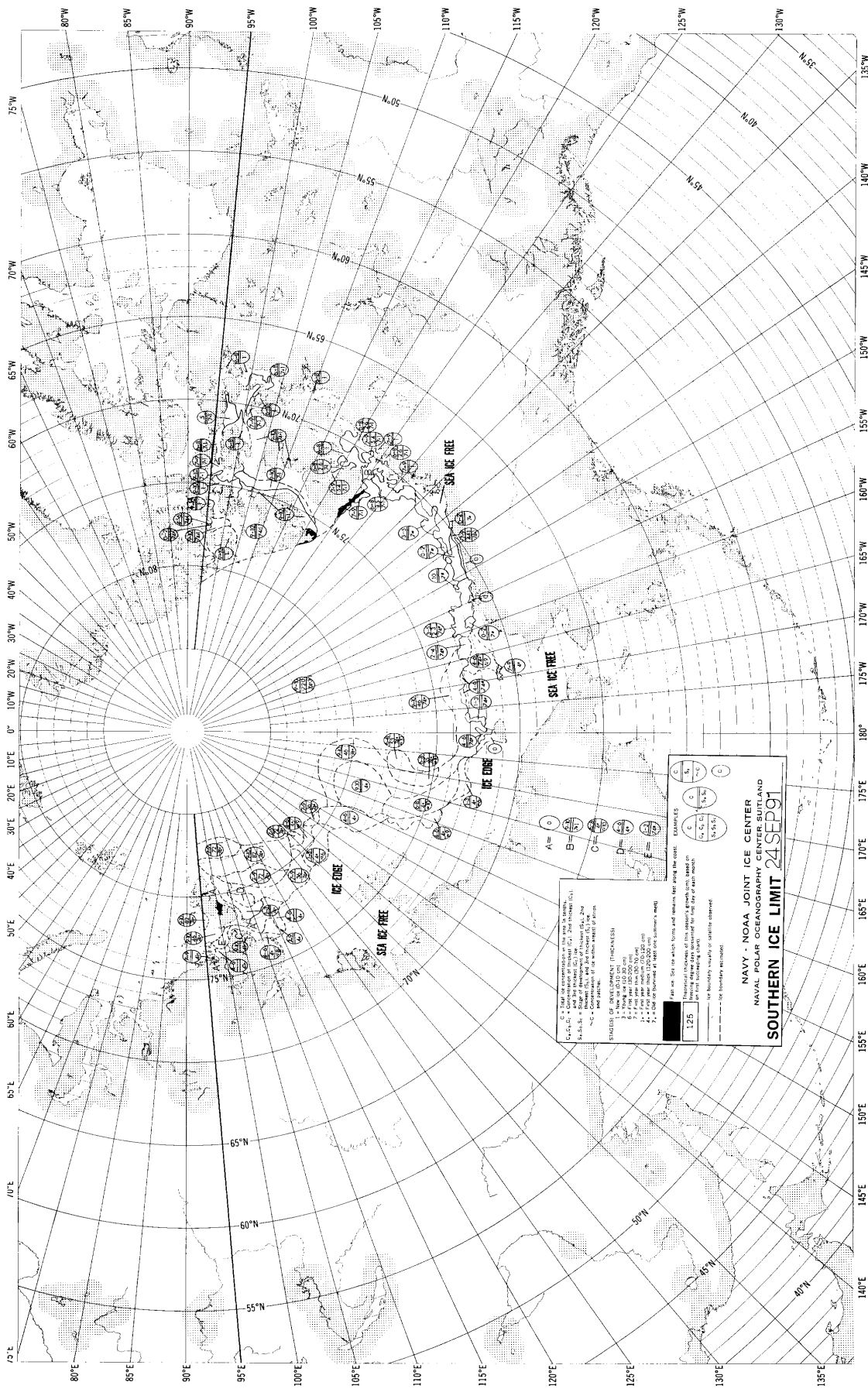


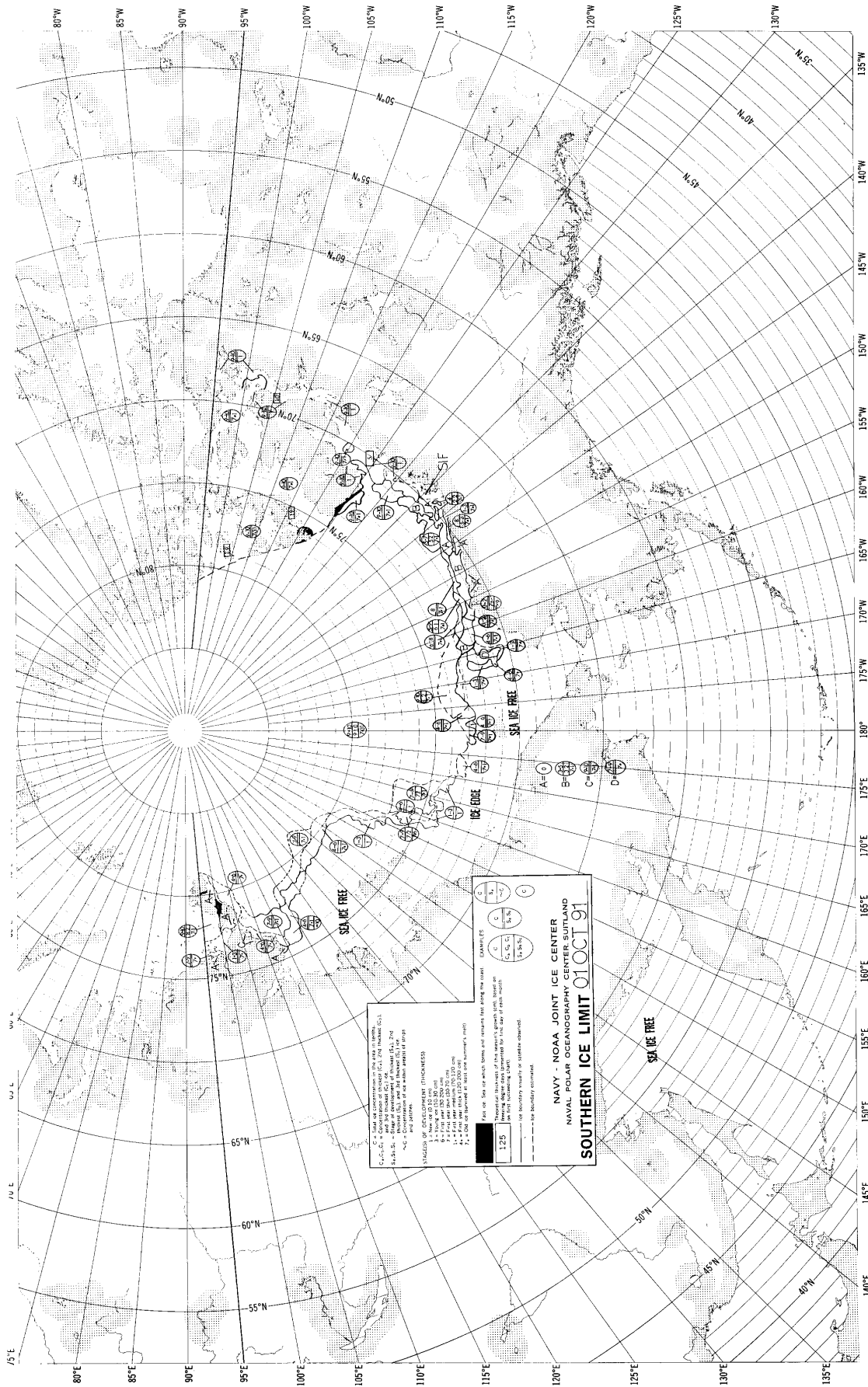


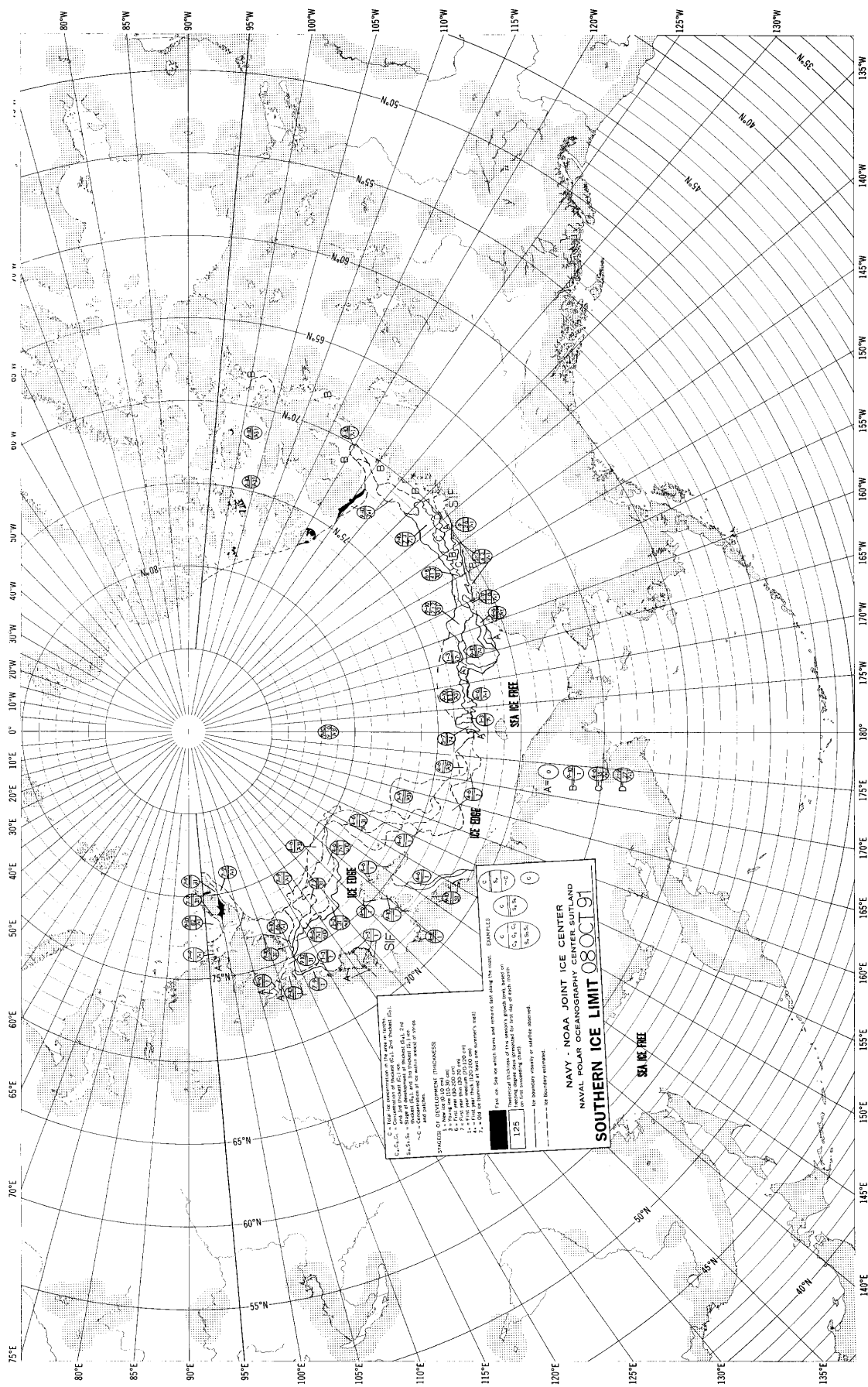


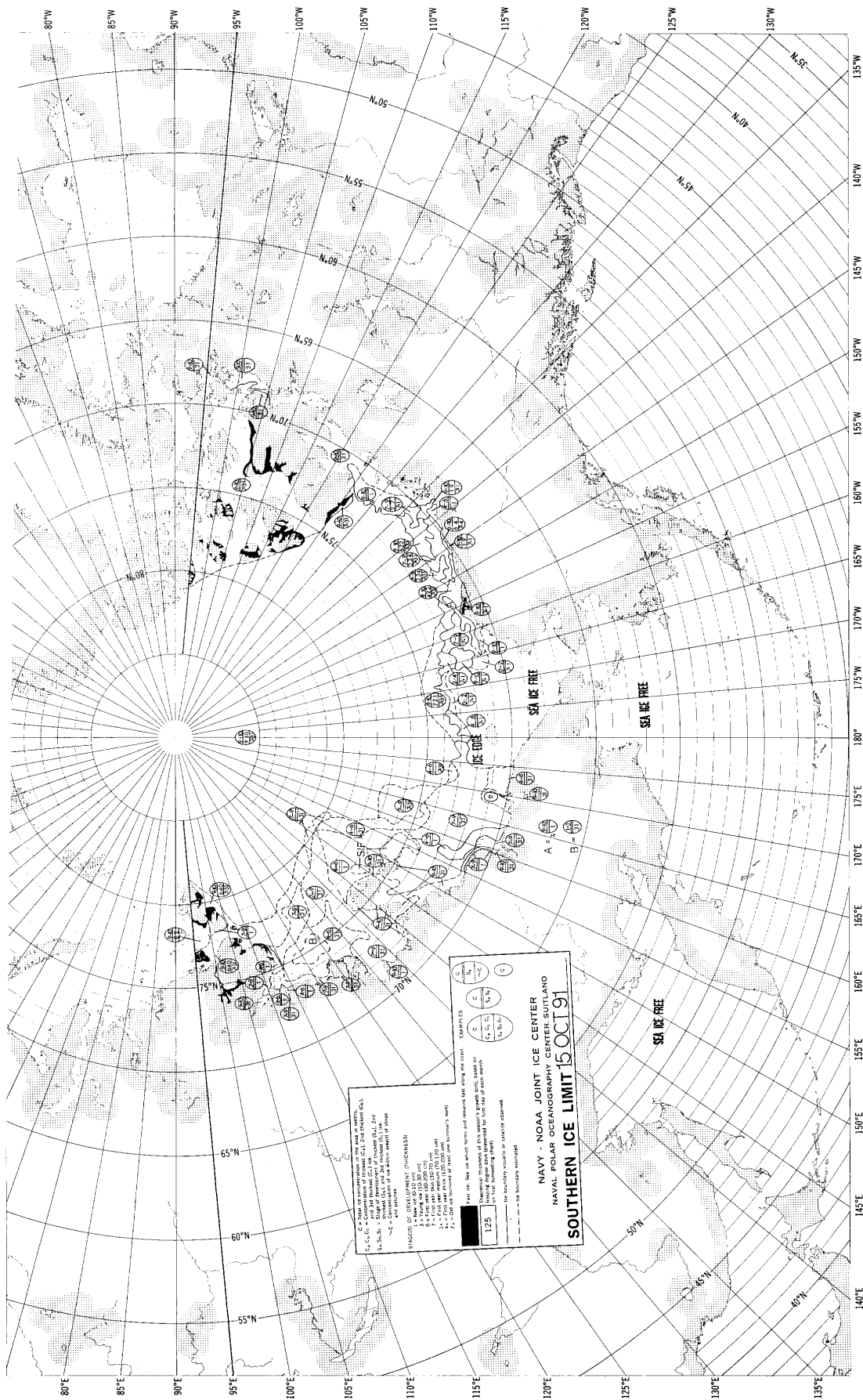


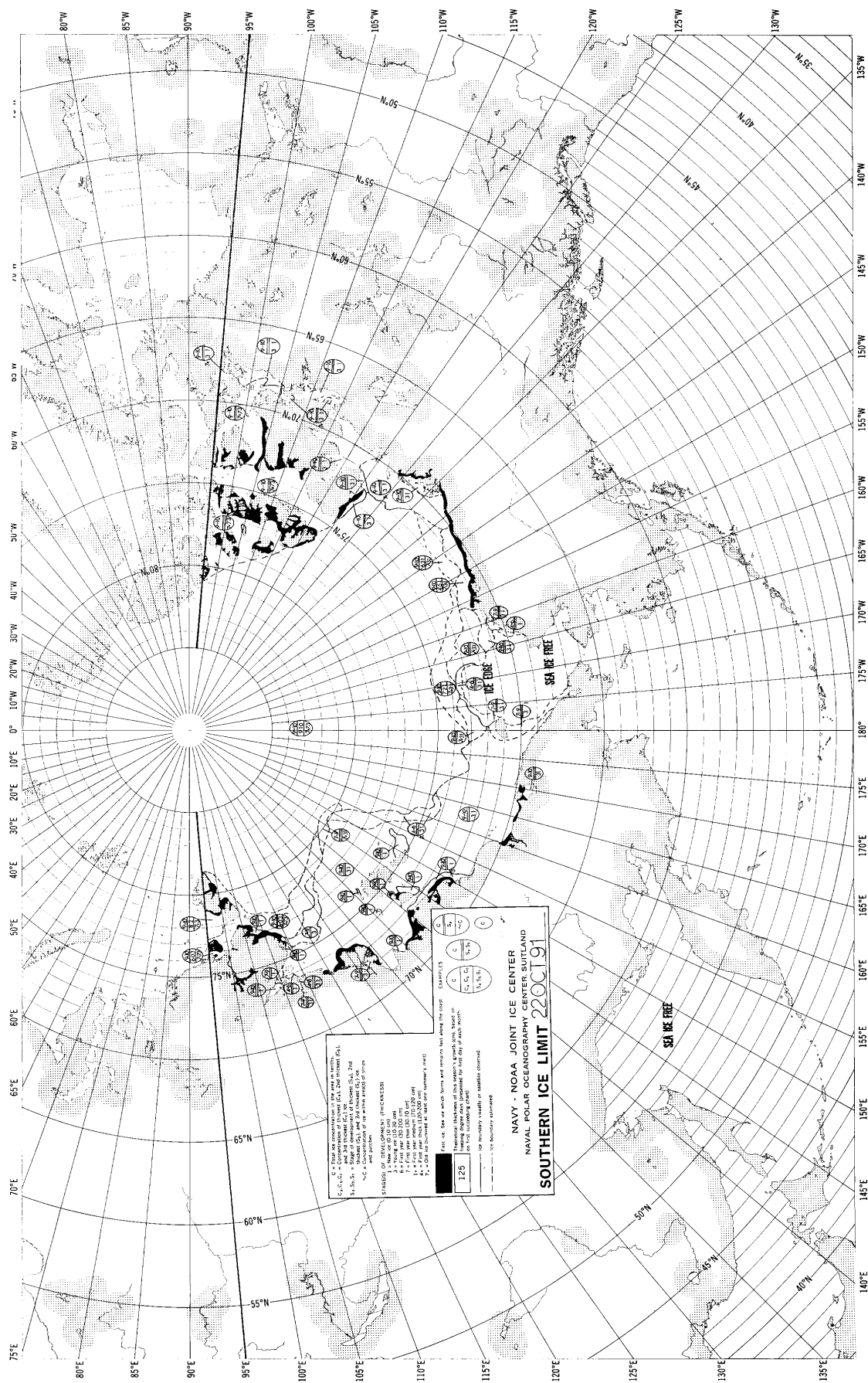


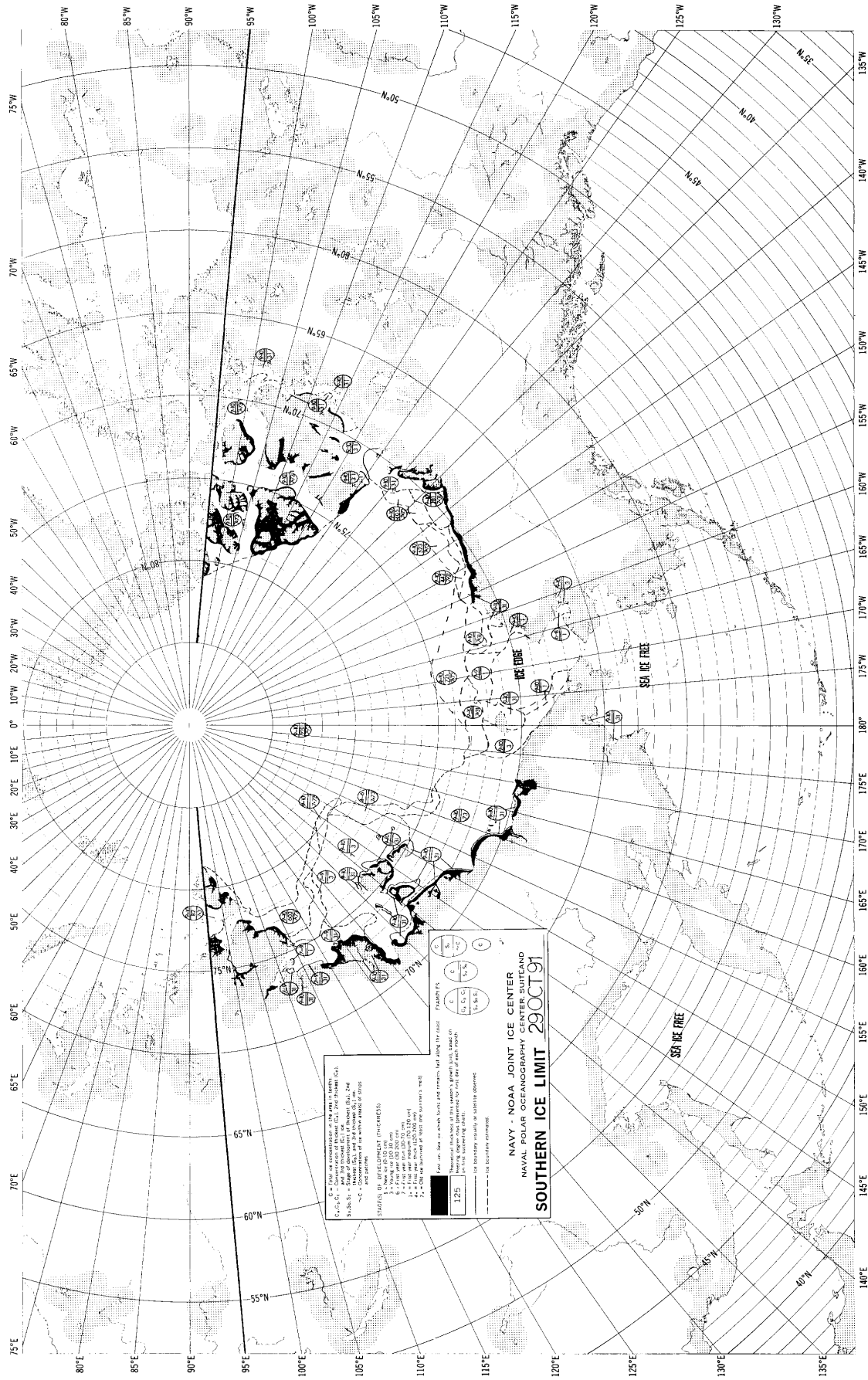


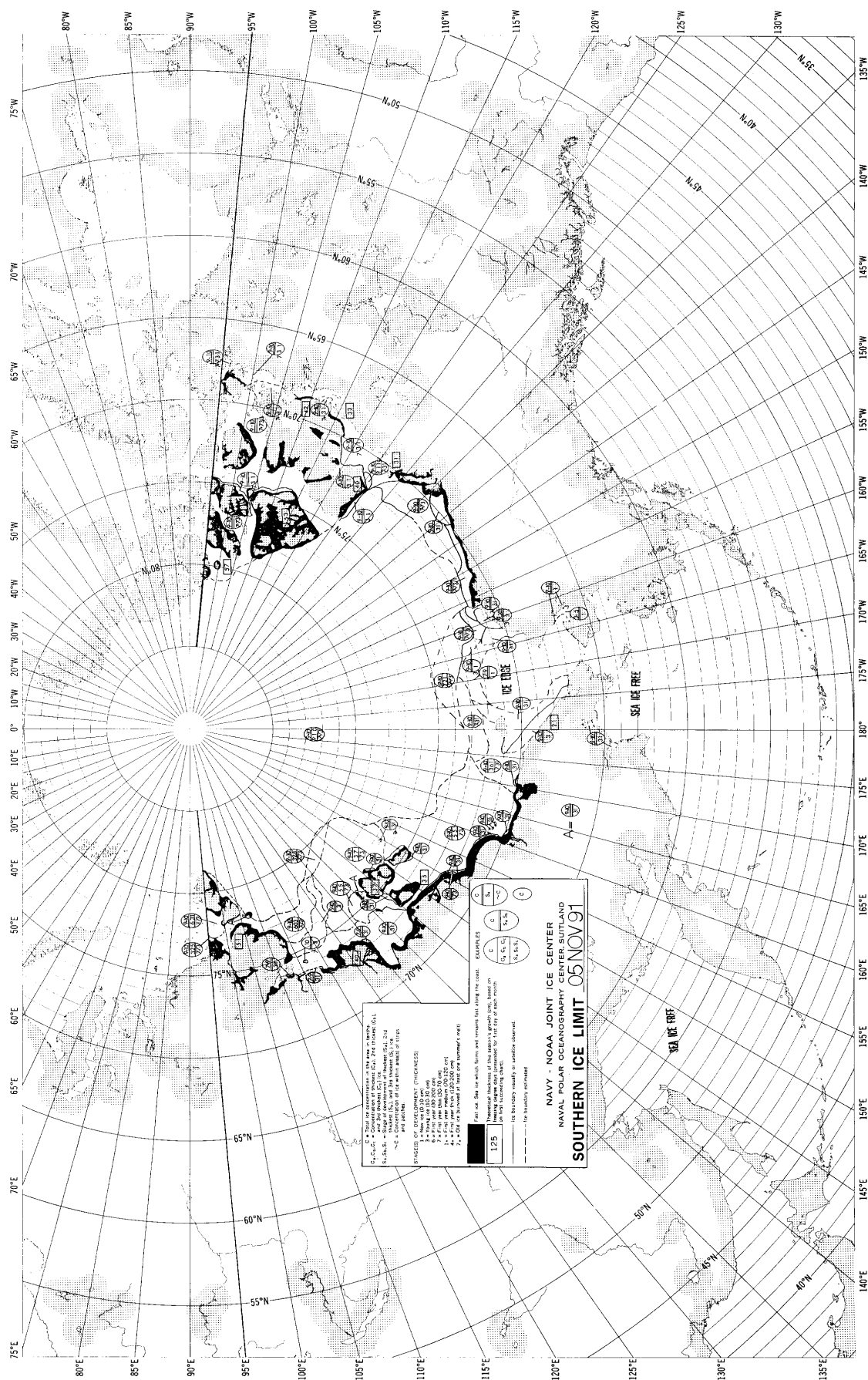


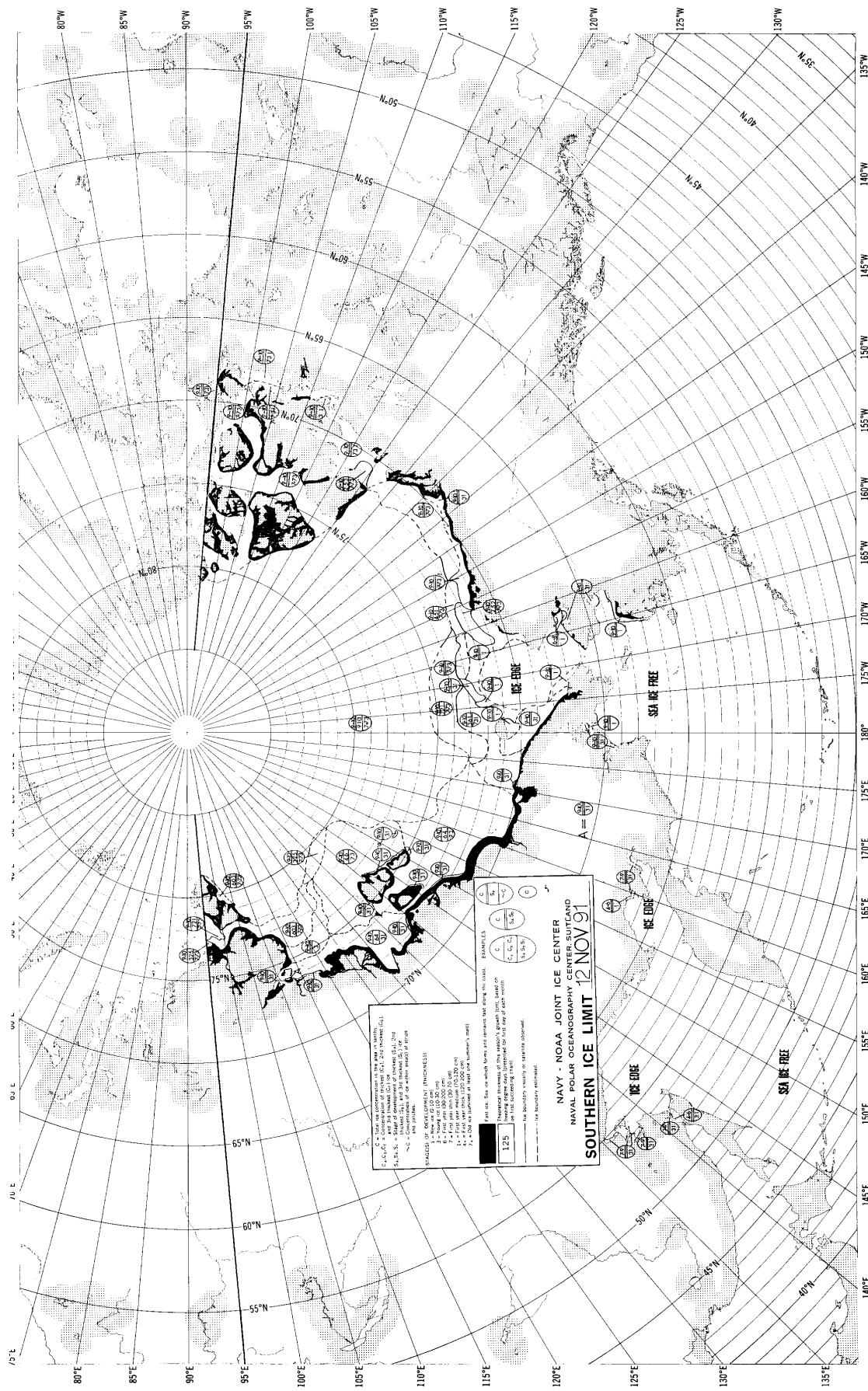


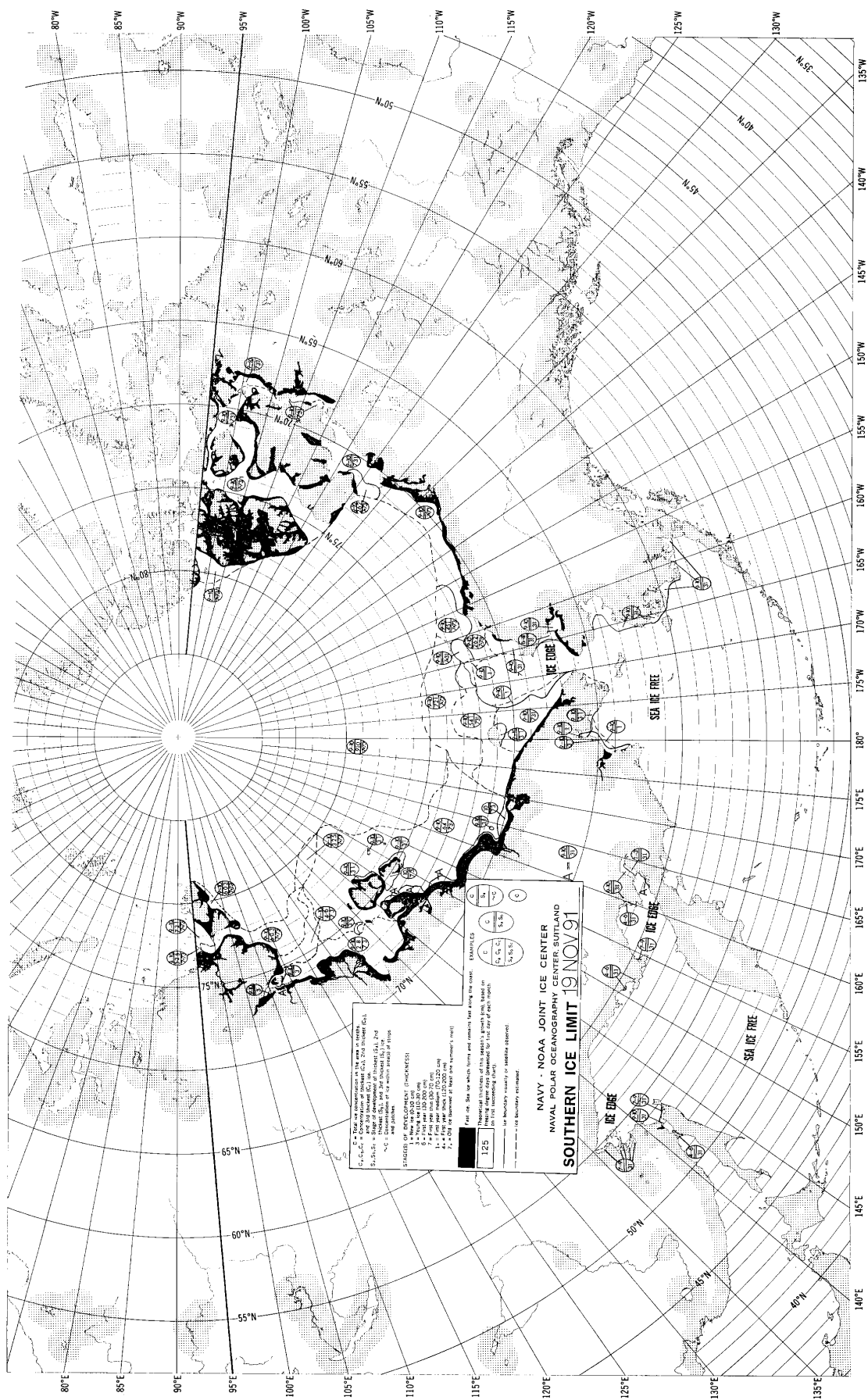


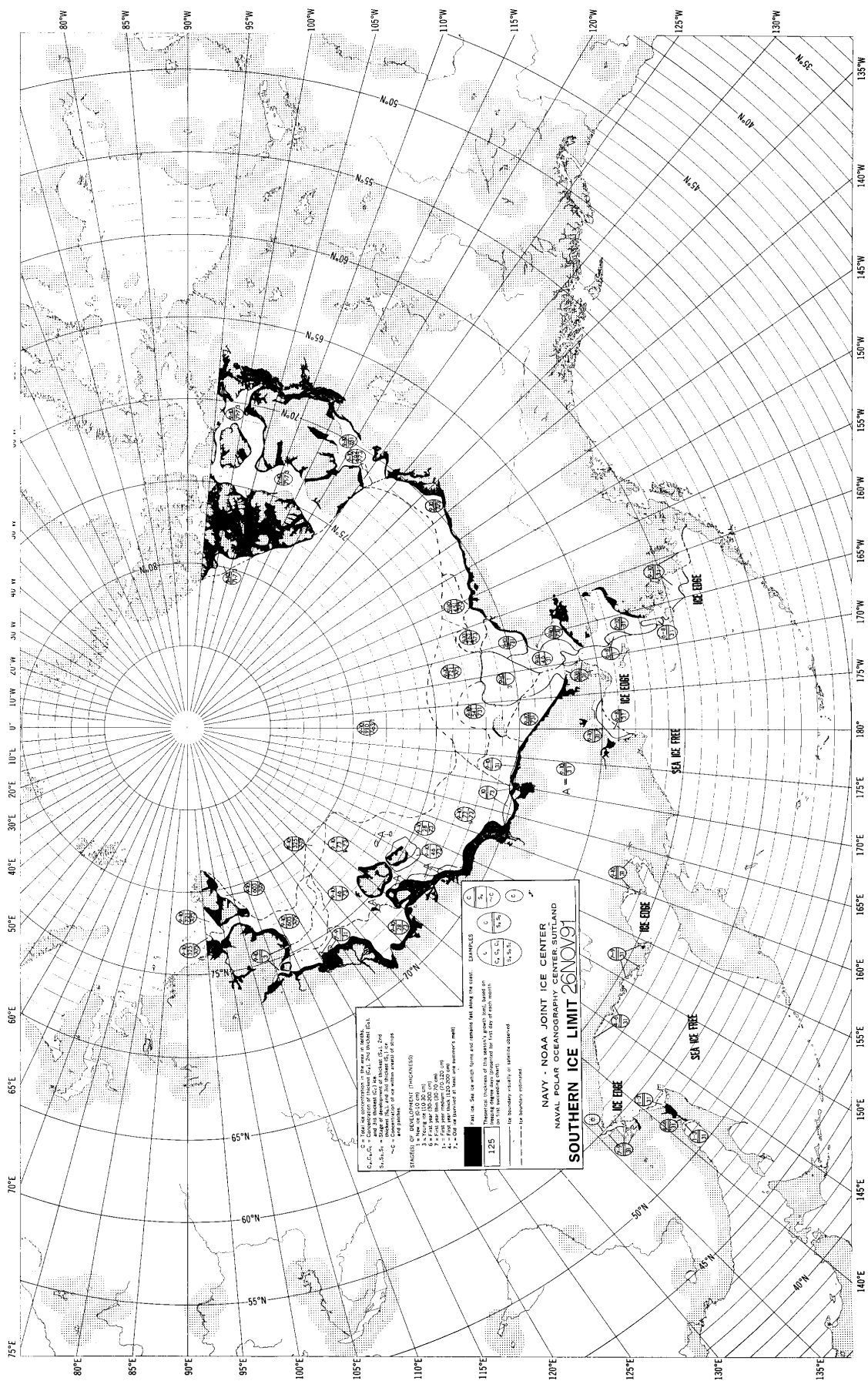


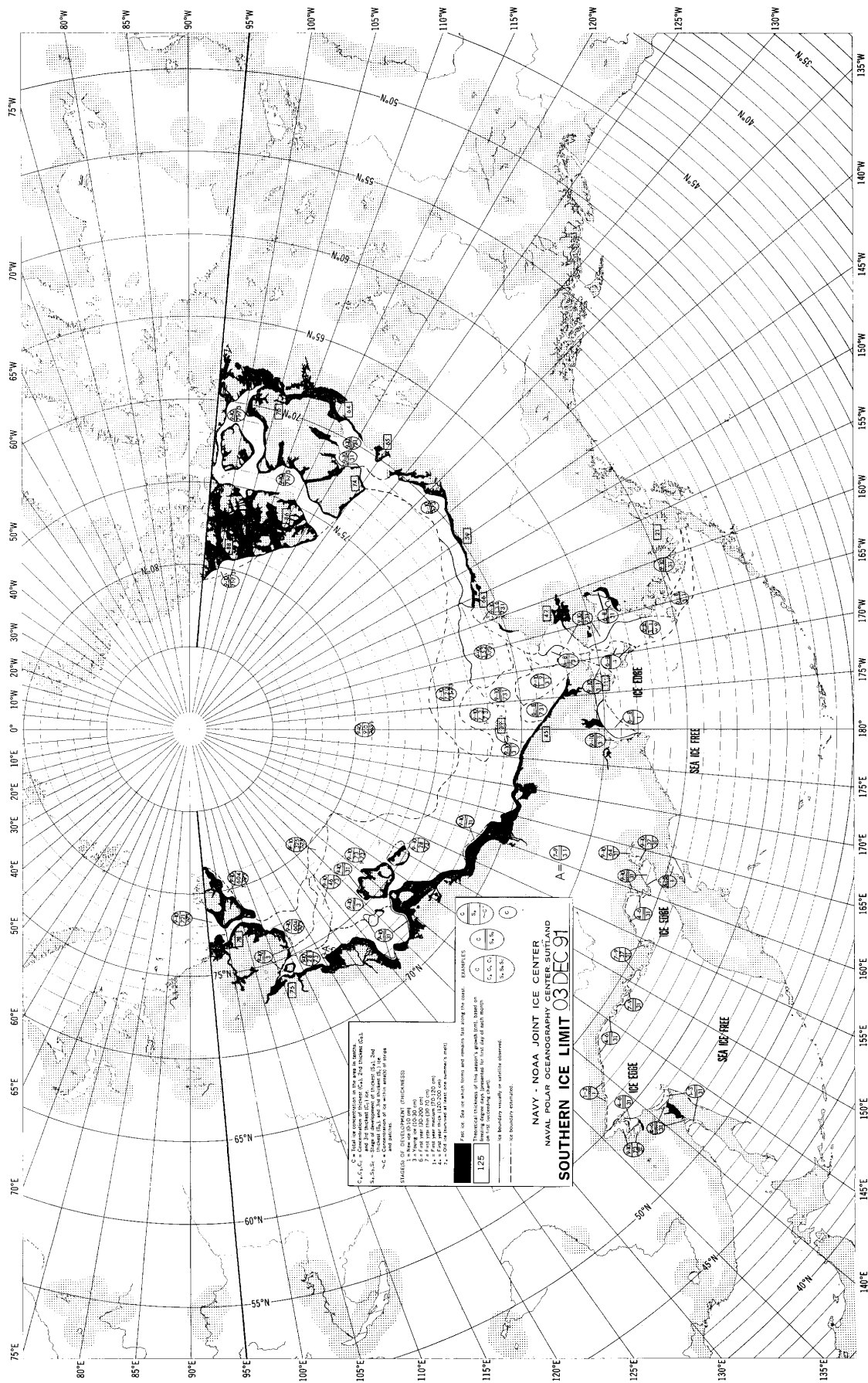


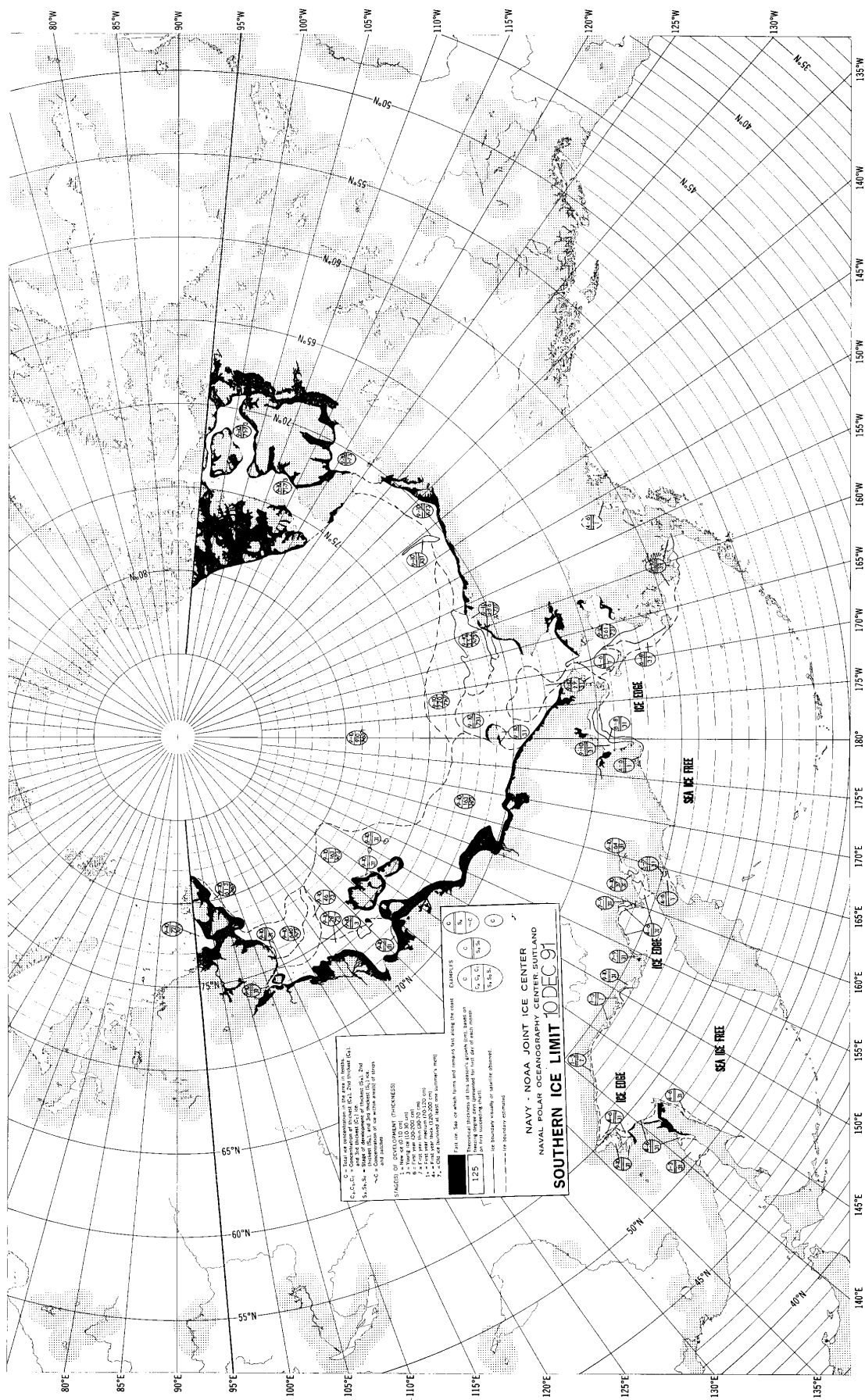


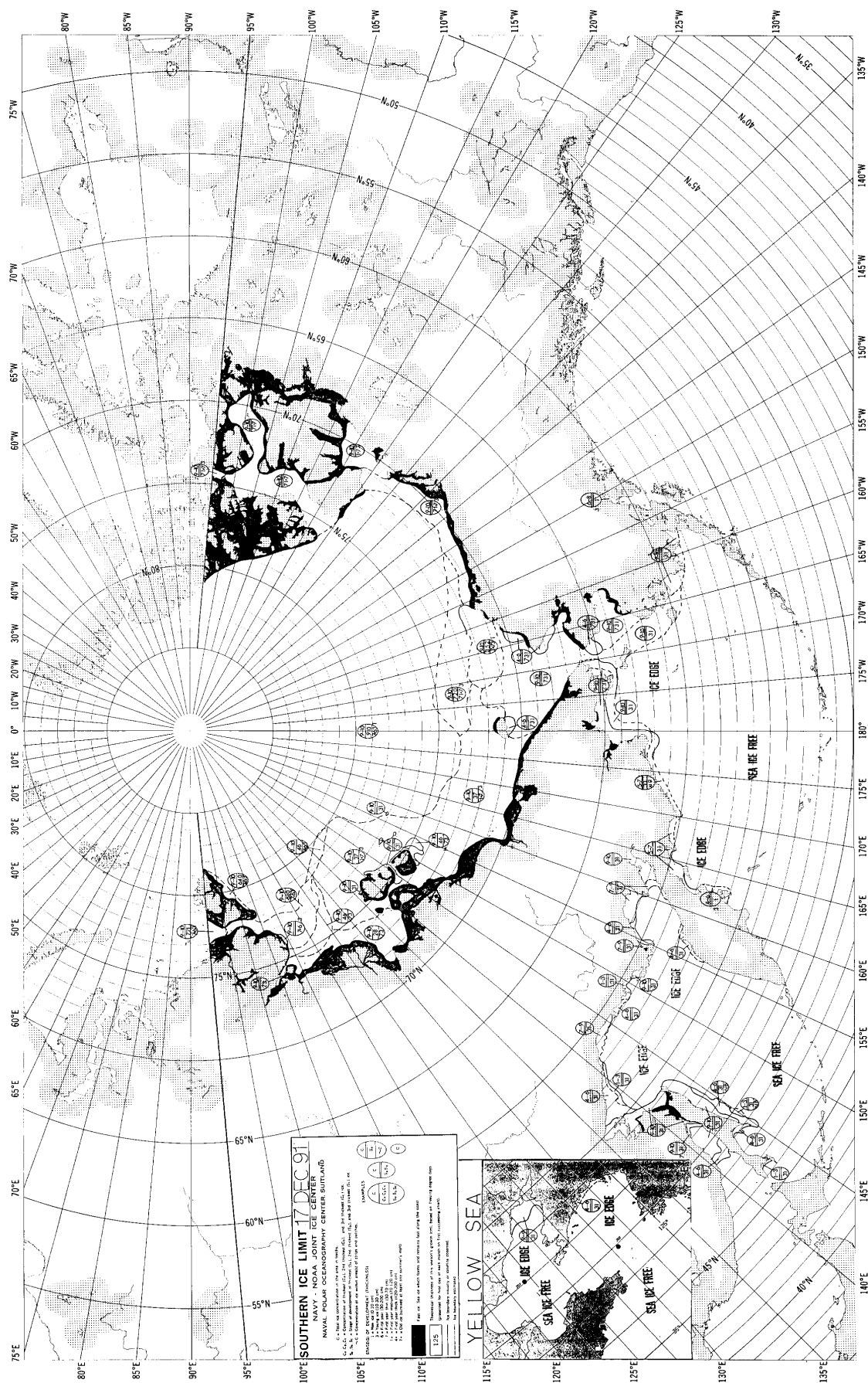


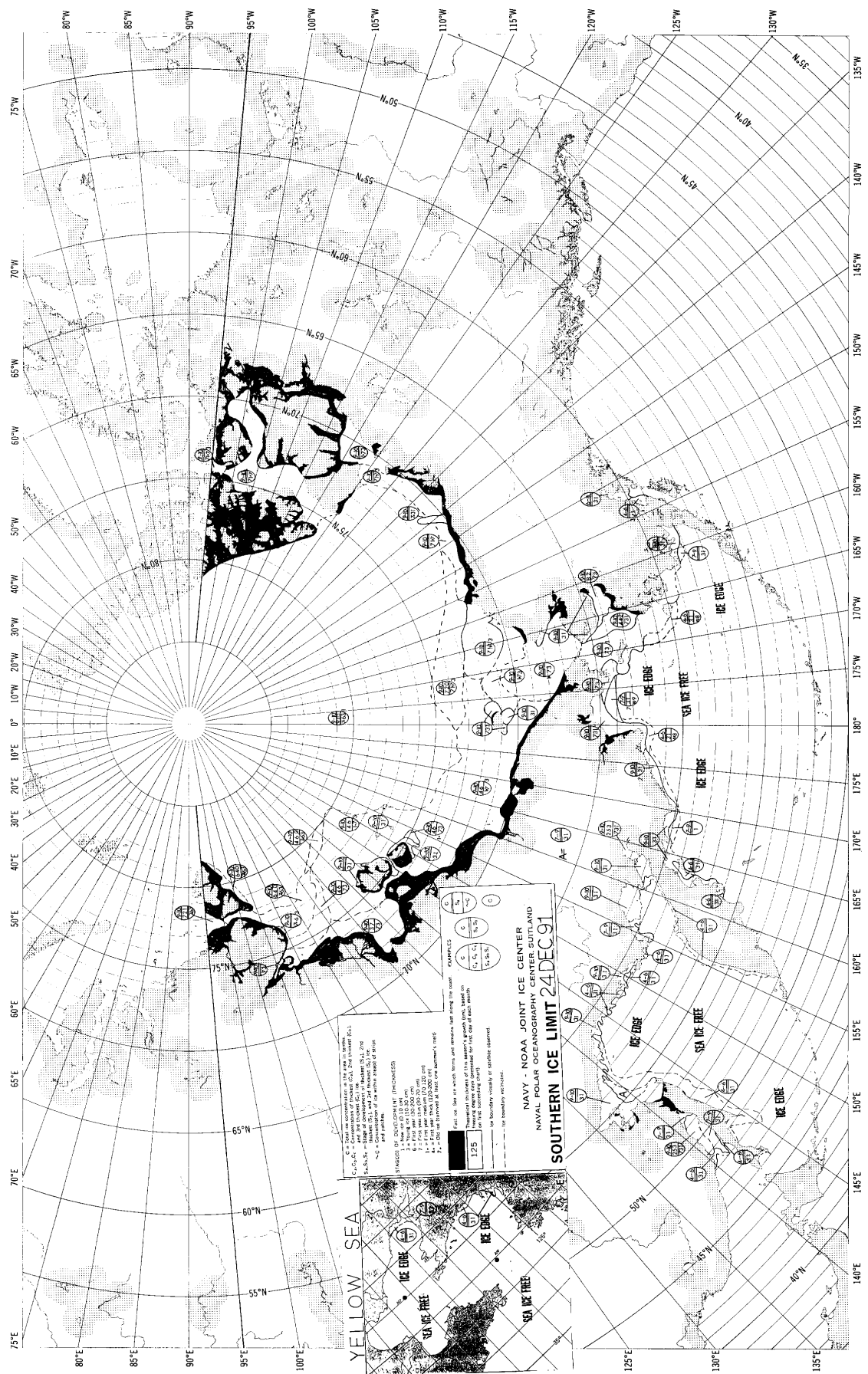


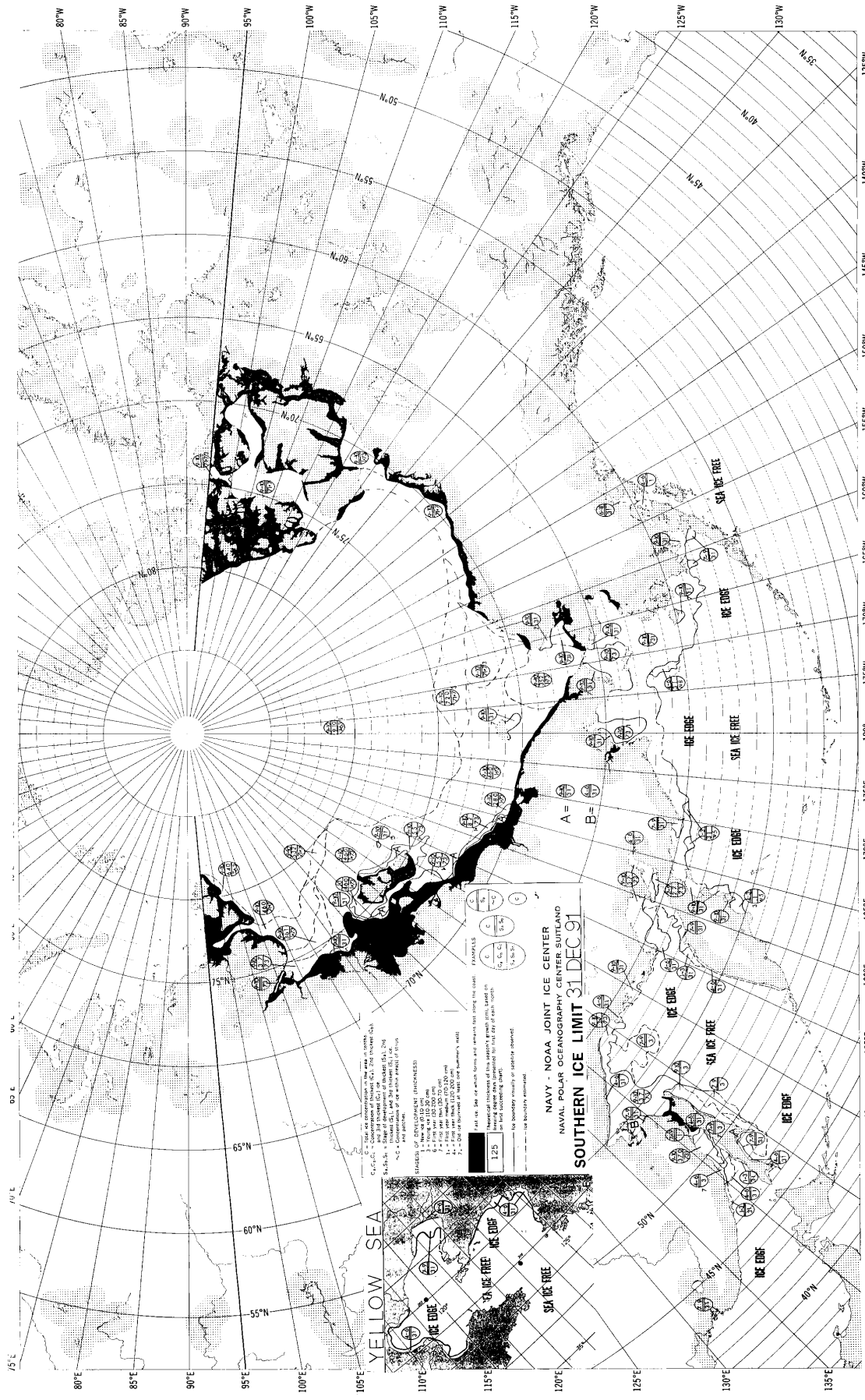


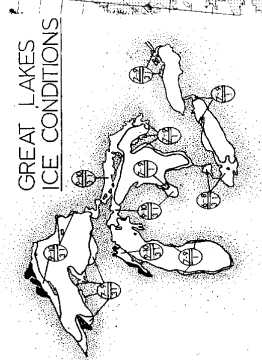
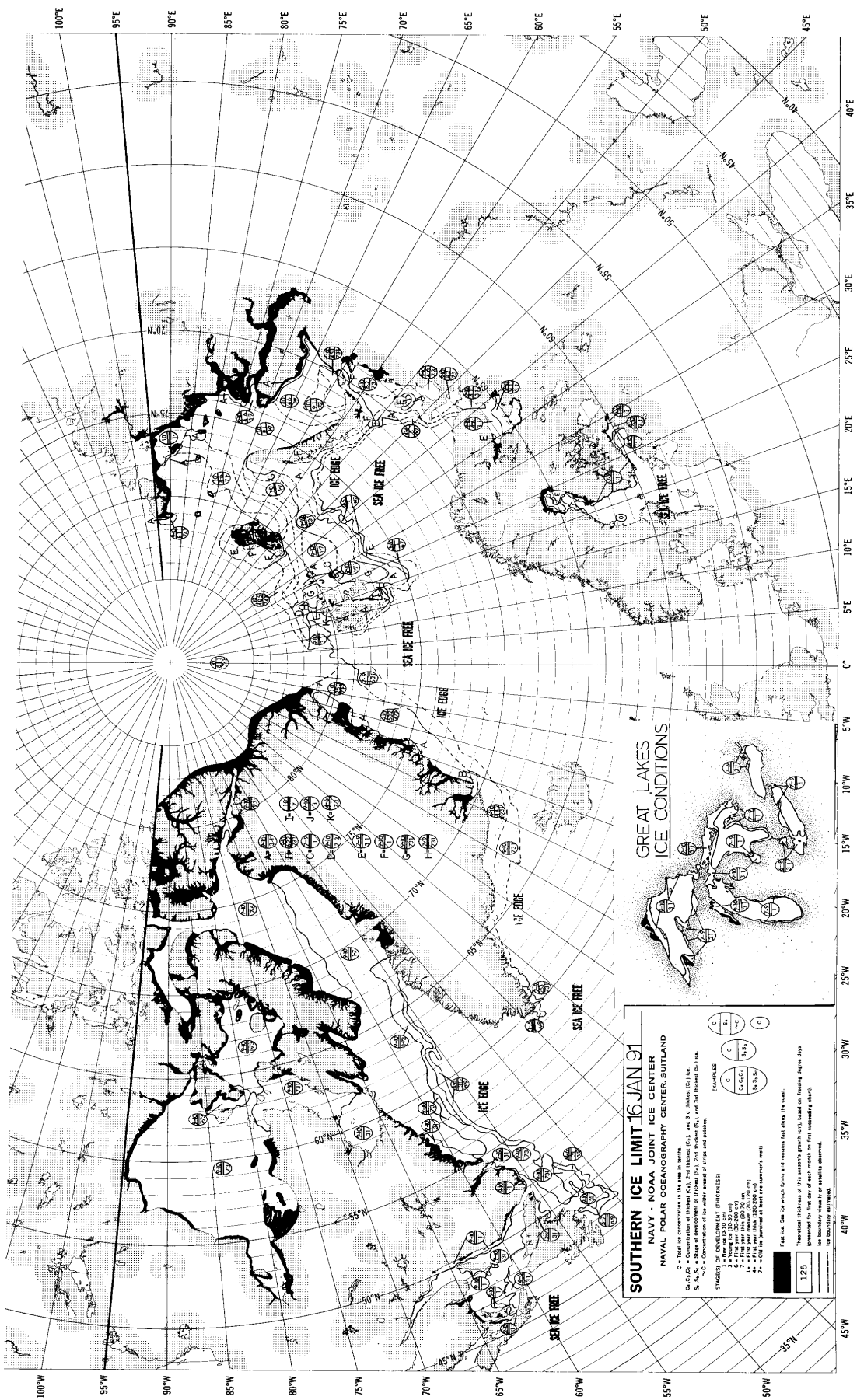












SOUTHERN ICE LIMIT 16 JAN 91
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C = Total ice concentration in the area in percent.
 C₁C₂C₃C₄ = Concentration of thickness (C₁), and 3rd thickness (C₂), and 4th thickness (C₃), and 5th thickness (C₄).

STAGES OF DEVELOPMENT (THICKNESS)

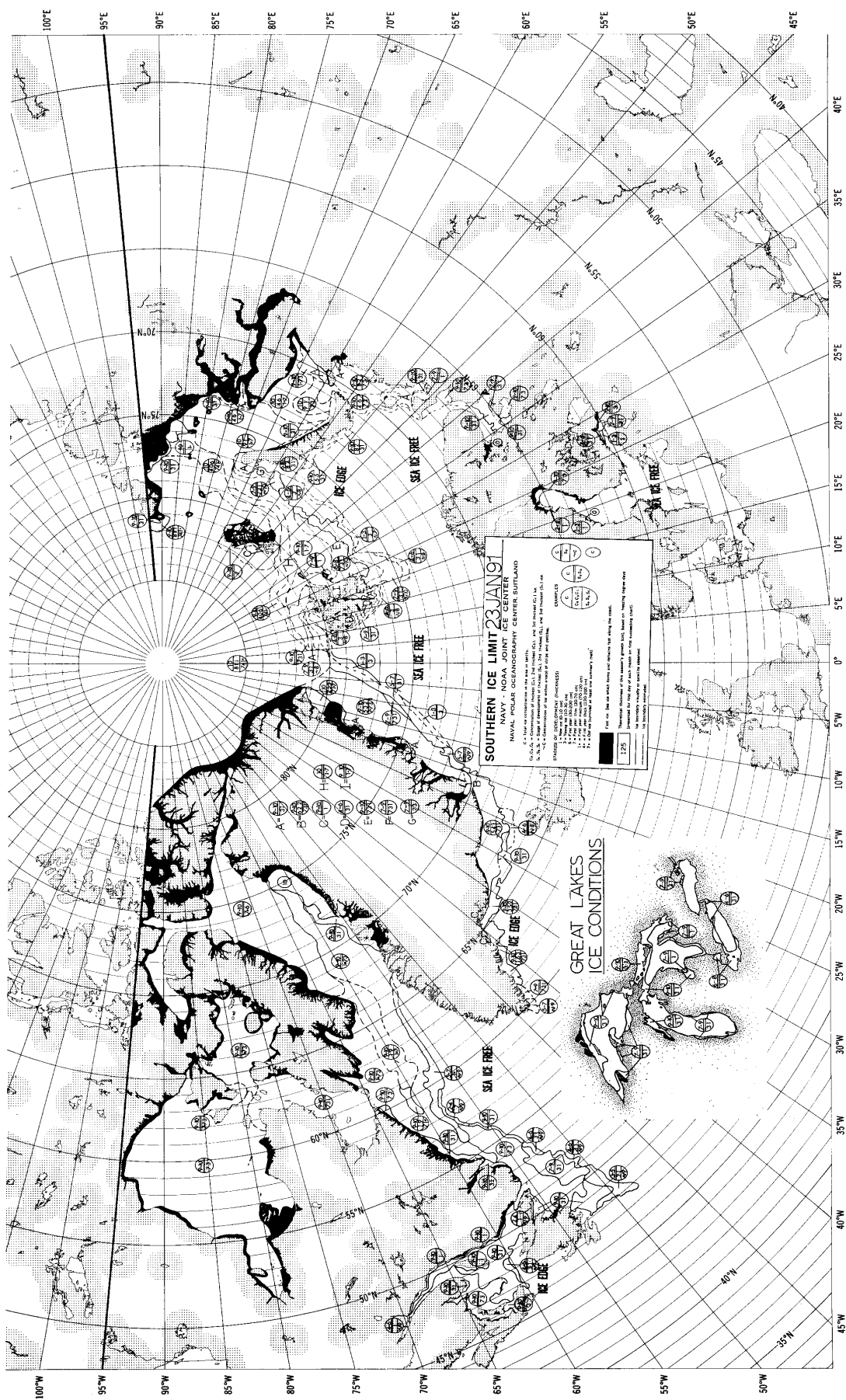
1	2	3	4	5	6	7
0-100 mm	100-200 mm	200-300 mm	300-400 mm	400-500 mm	500-600 mm	600-700 mm

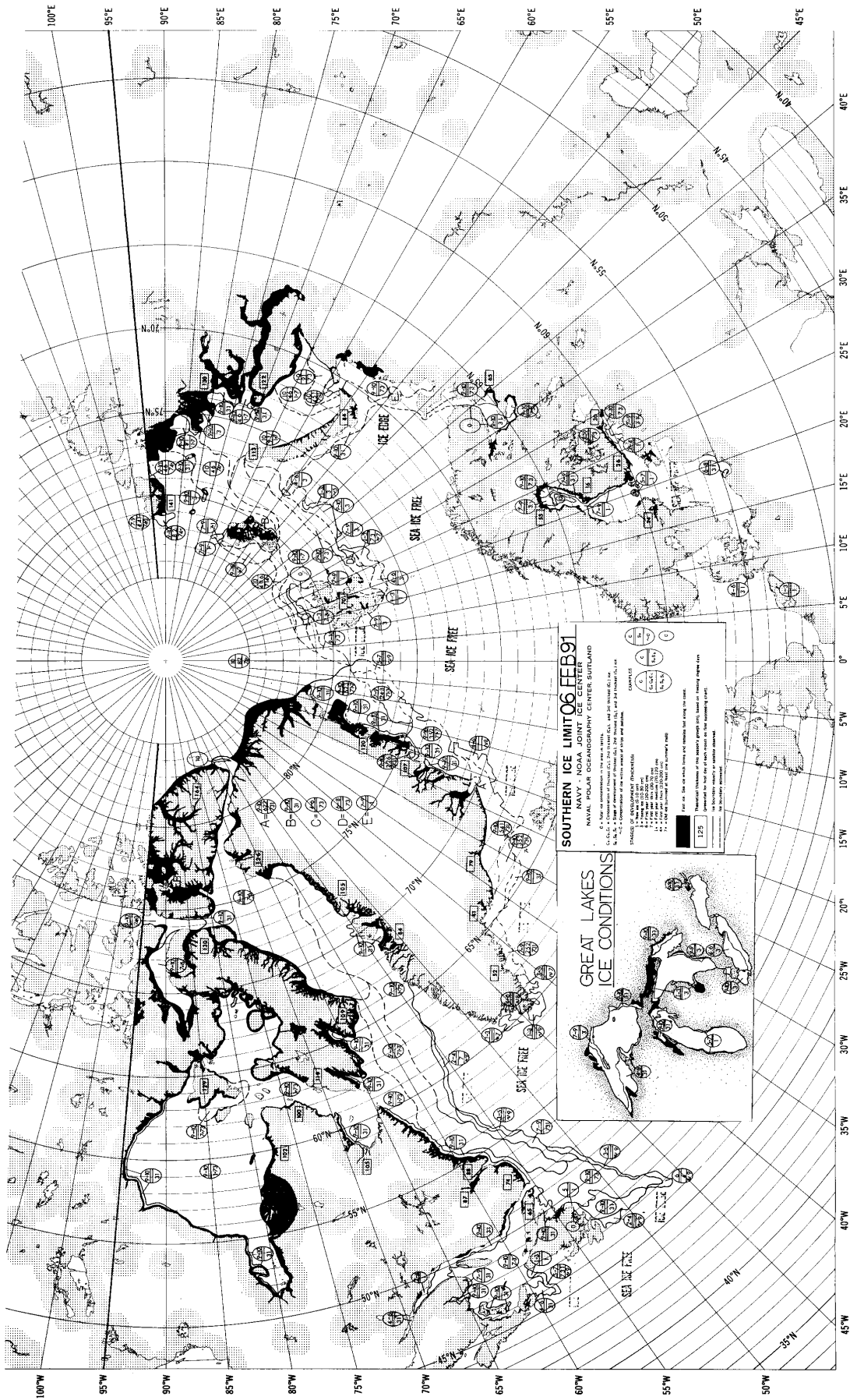
EXAMPLES

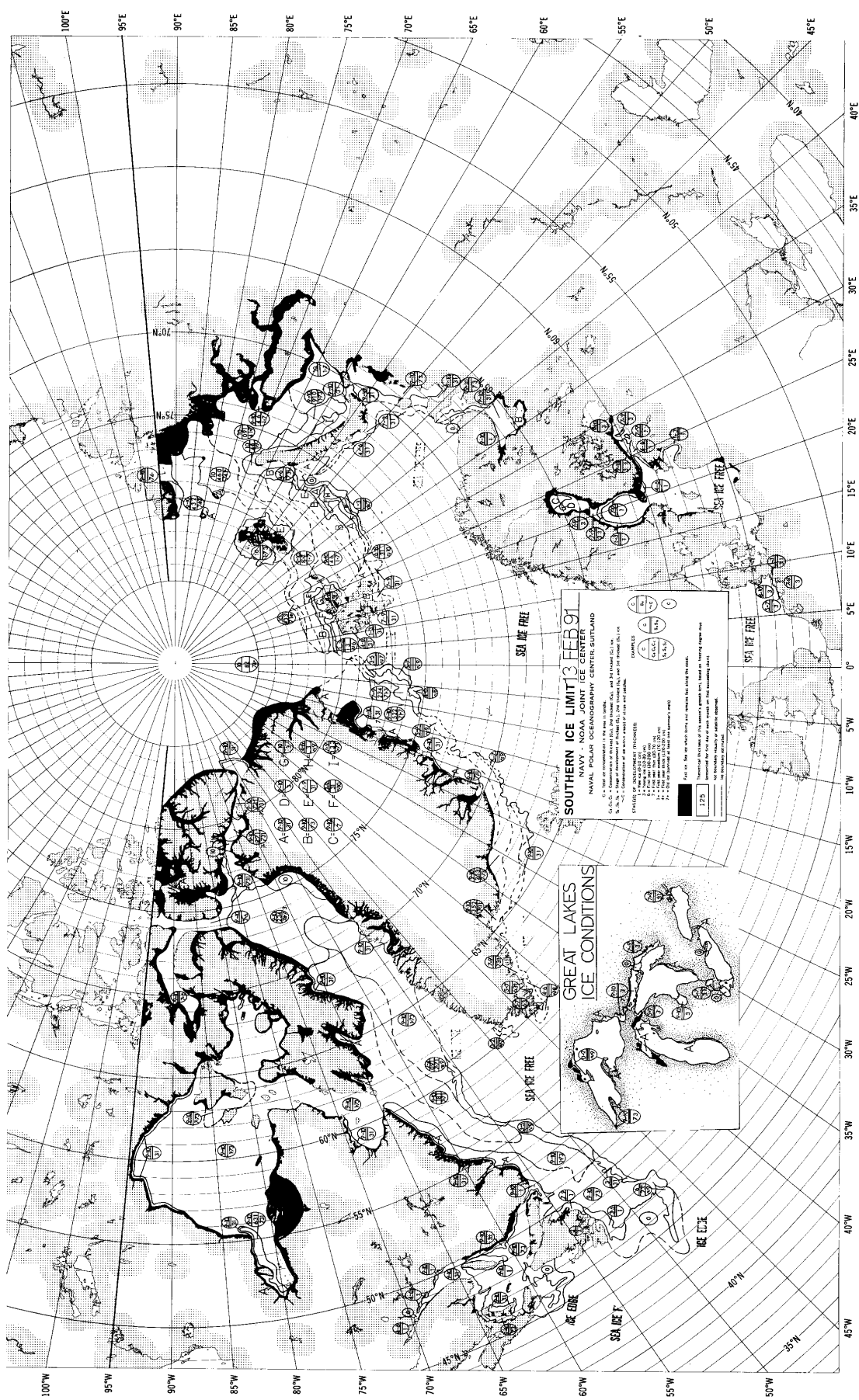
C	C ₁ C ₂ C ₃ C ₄	C	C ₁ C ₂ C ₃ C ₄
100	100 100 100 100	100	100 100 100 100

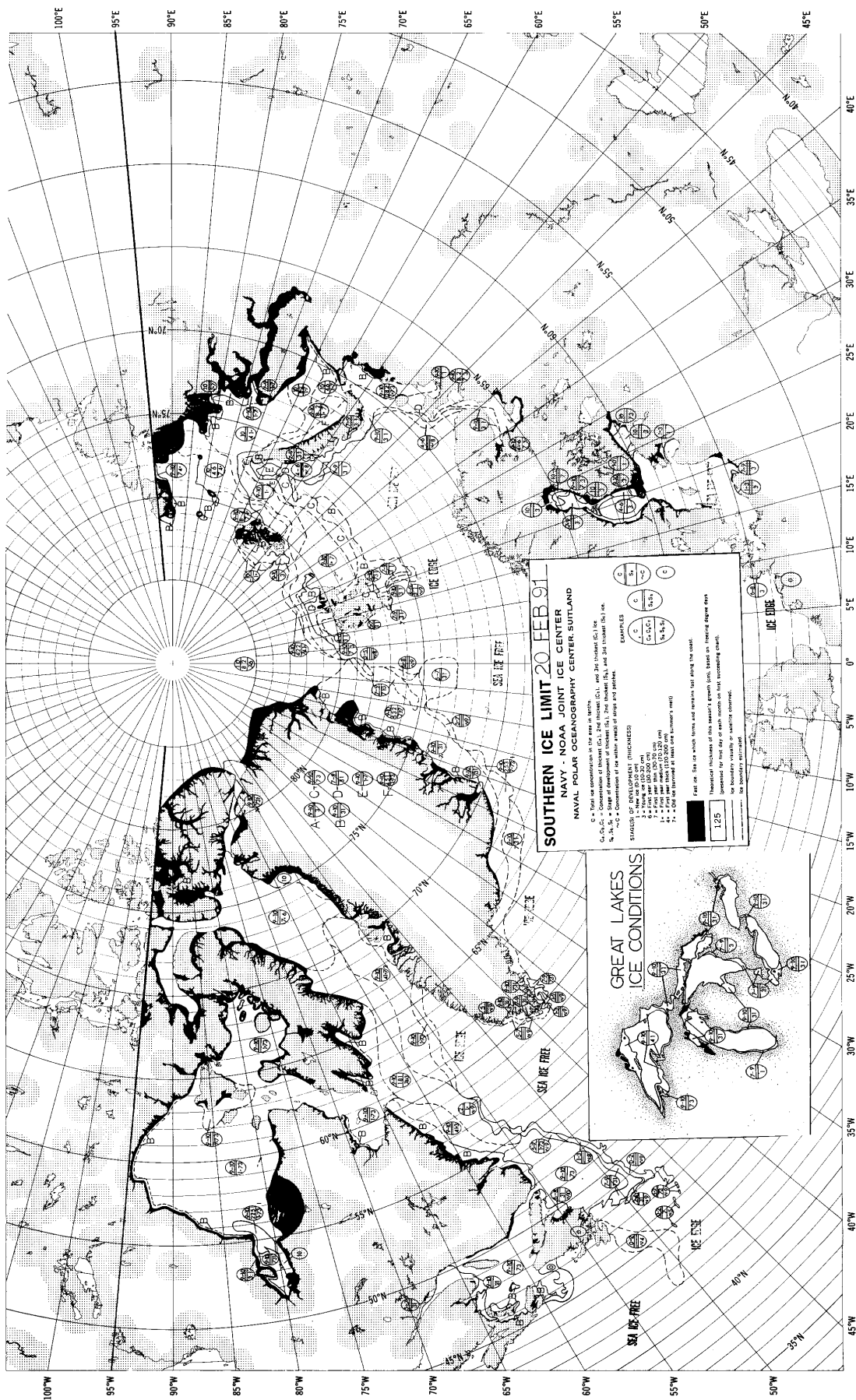
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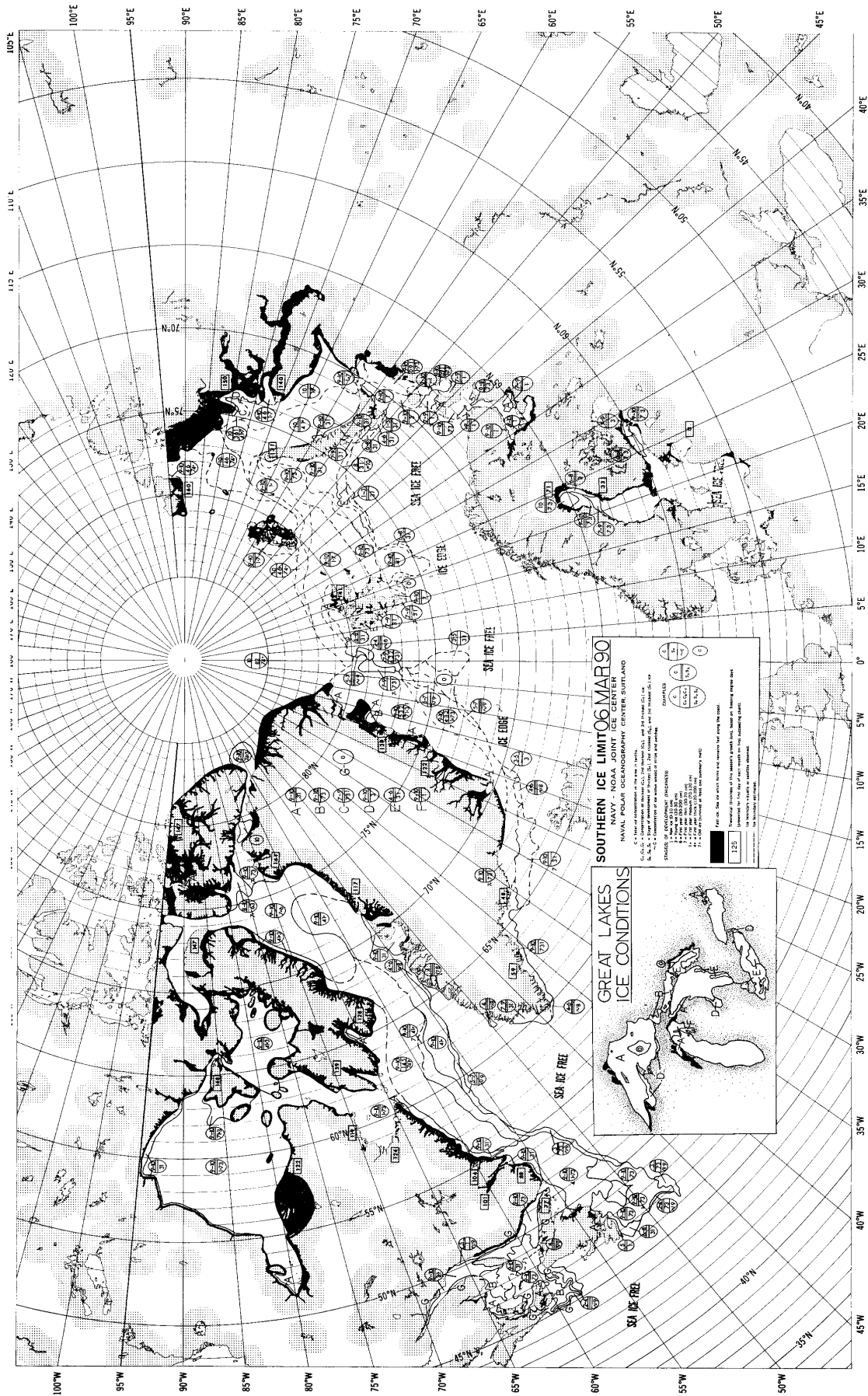
Read ice. See ice which forms and extends last along the coast.
 Thicknesses of this season's growth limits, based on timing degree days.
 The boundary between the ice and the open water is shown by a dashed line.

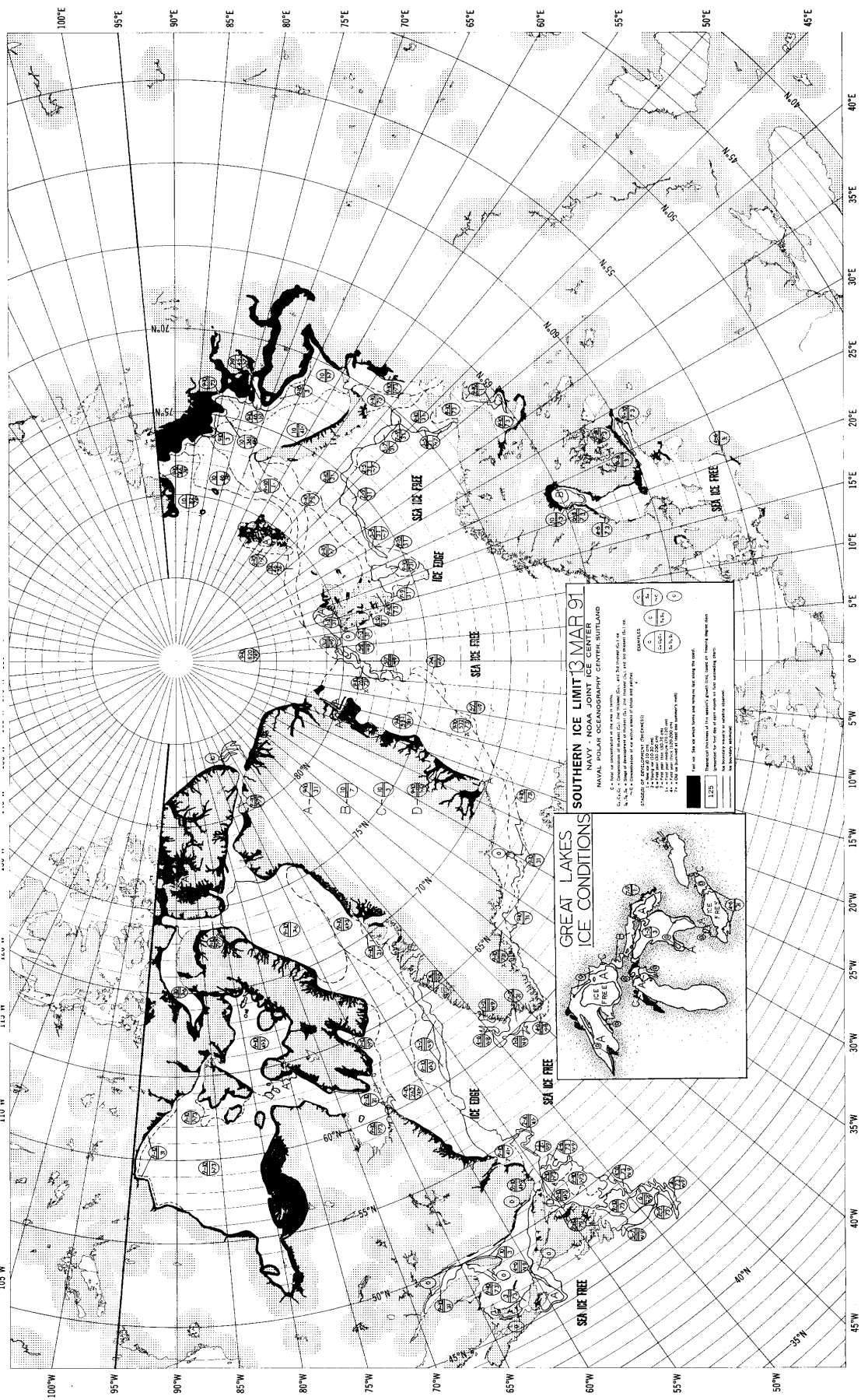


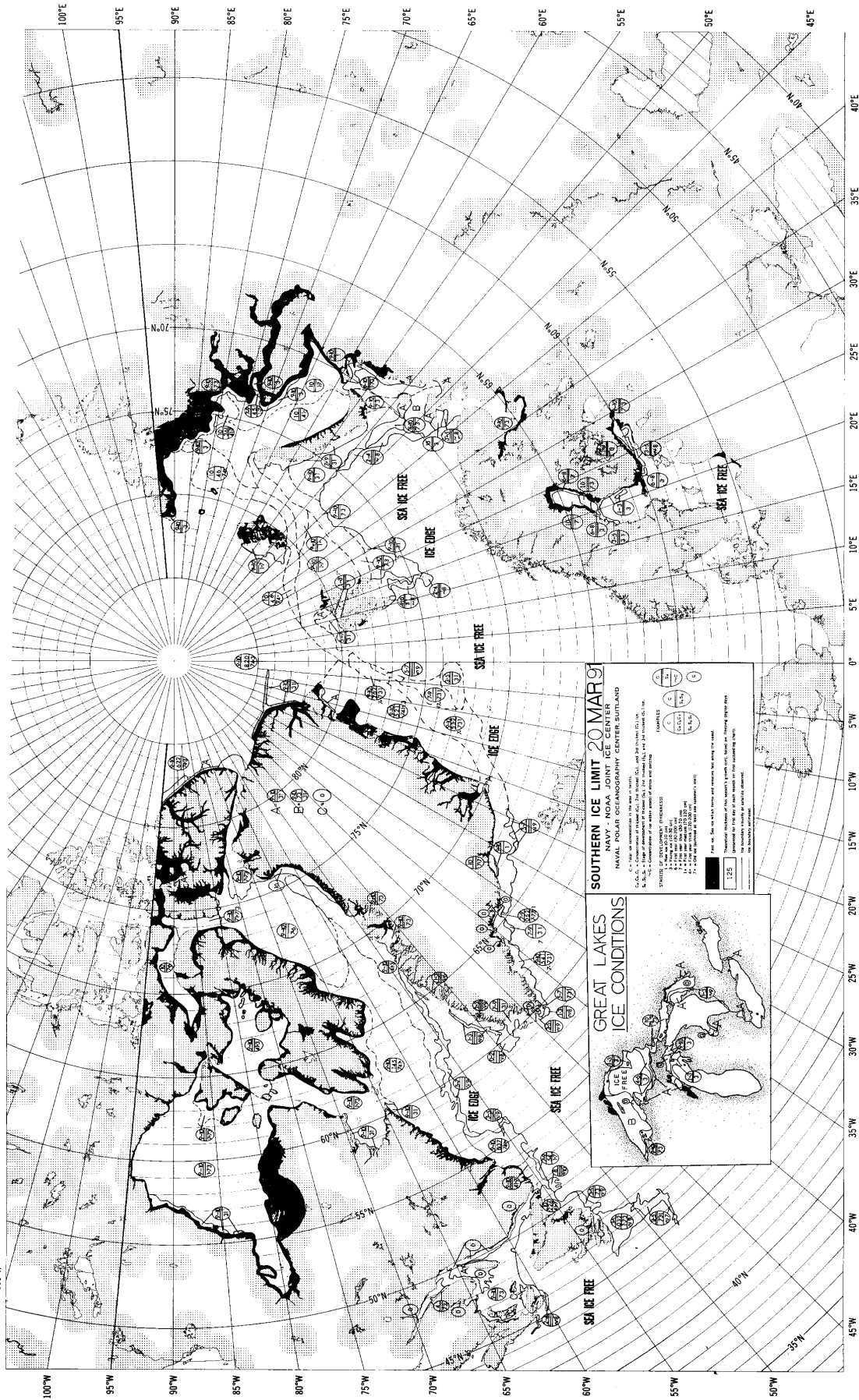












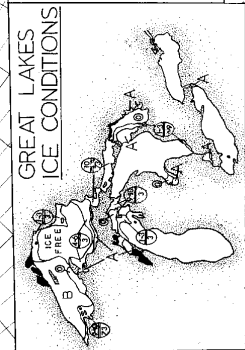
SOUTHERN ICE LIMIT 20 MAR 91
 NAVY - NOAA JOINT ICE CENTER
 NAVAL POLAR OCEANOGRAPHY CENTER BUTLAND

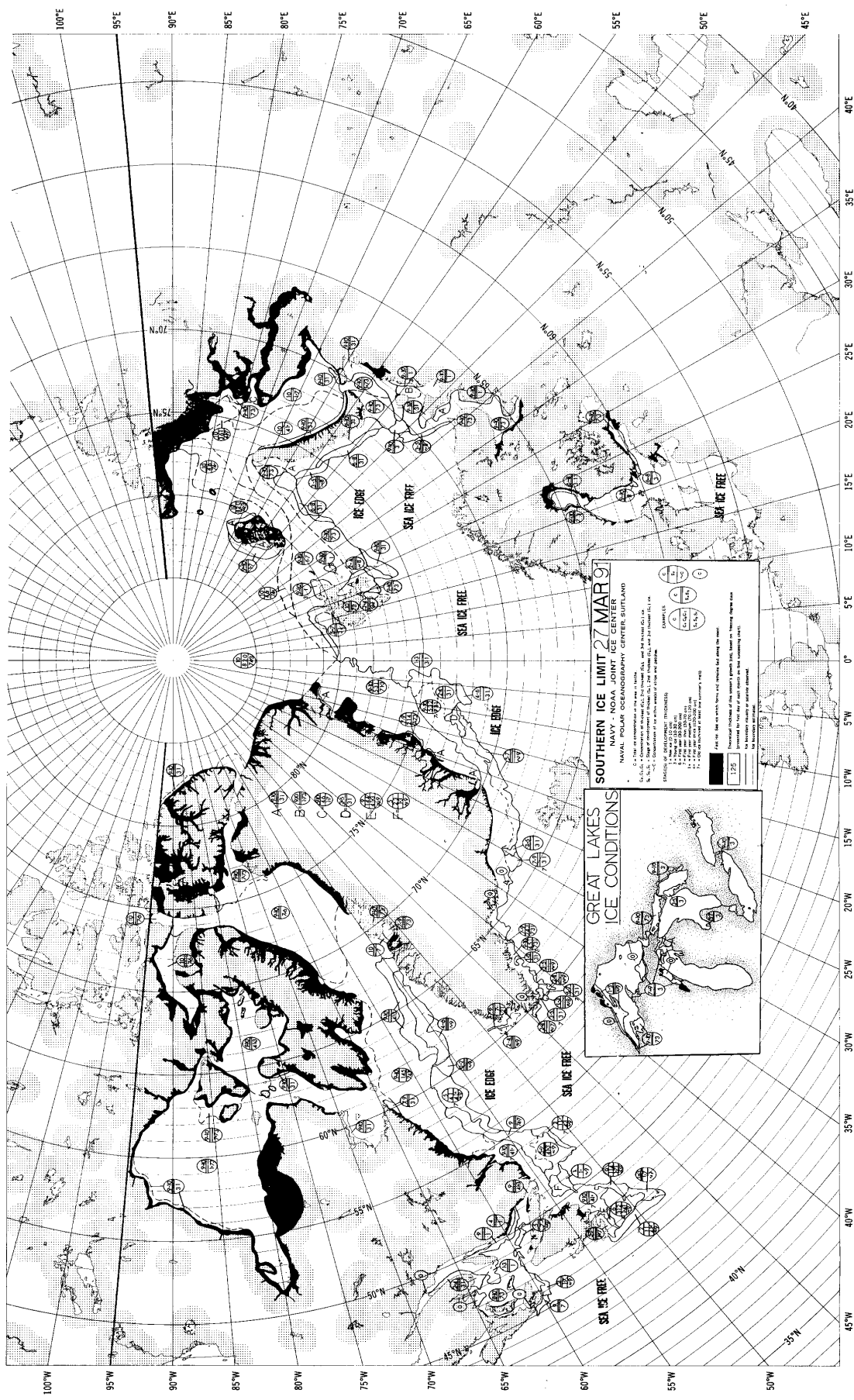
CLAS - Concentration of Ice in Area (0-100%)
 THICK - Thickness of Ice in Area (0-100%)
 S.W. - Submarine of Ice Area (0-100%)

STAGES OF DEVELOPMENT: (1) INITIAL (2) GROWING (3) PEAK (4) MELTING (5) BROKEN (6) CRUSHED (7) FLOES (8) BRICKS (9) SLICES (10) CHIPS (11) DUST (12) SLUSH (13) WATER

For use: Map on which lines and symbols are shown for use.

1:25
 (measured for first day of each month in this hemisphere only)
 The boundary is shown.





SOUTHERN ICE LIMIT 27 MAR 69
NAVAL POLAR OCEANOGRAPHY CENTER, SUITLAND

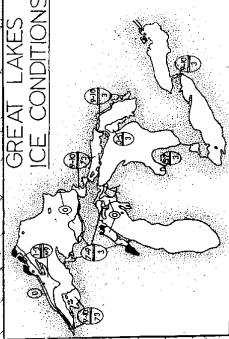
1. This is a map of the Great Lakes region showing the southern ice limit on March 27, 1969. The map is based on data from the Naval Polar Oceanography Center, Suitland, and the Naval Oceanographic Office, San Diego. The map shows the ice limit for each of the five Great Lakes: Superior, Michigan, Huron, Erie, and Ontario. The ice limit is shown as a line with various symbols and numbers indicating ice type and thickness. The map is based on data from the Naval Polar Oceanography Center, Suitland, and the Naval Oceanographic Office, San Diego.

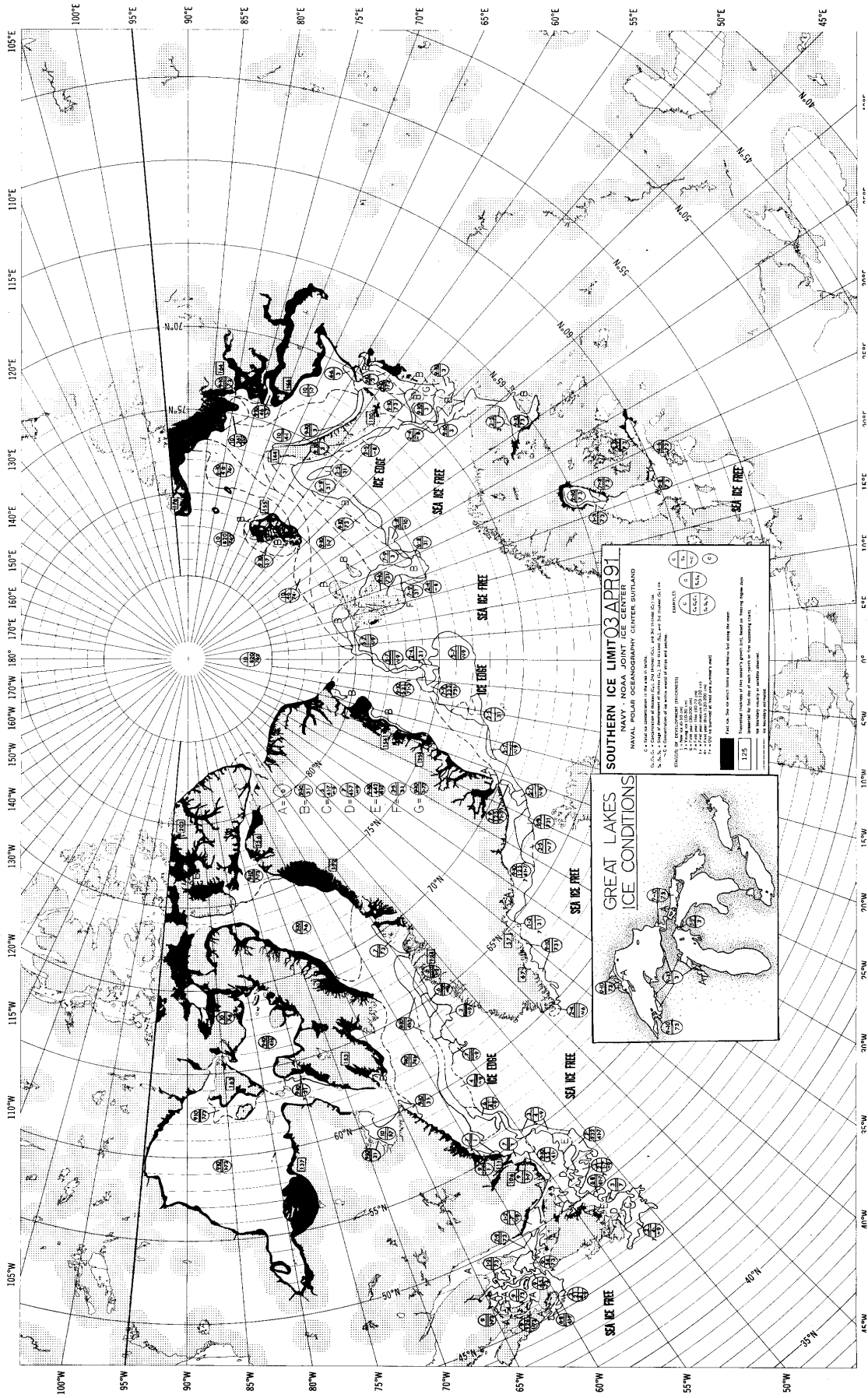
2. The map is based on data from the Naval Polar Oceanography Center, Suitland, and the Naval Oceanographic Office, San Diego. The map shows the ice limit for each of the five Great Lakes: Superior, Michigan, Huron, Erie, and Ontario. The ice limit is shown as a line with various symbols and numbers indicating ice type and thickness. The map is based on data from the Naval Polar Oceanography Center, Suitland, and the Naval Oceanographic Office, San Diego.

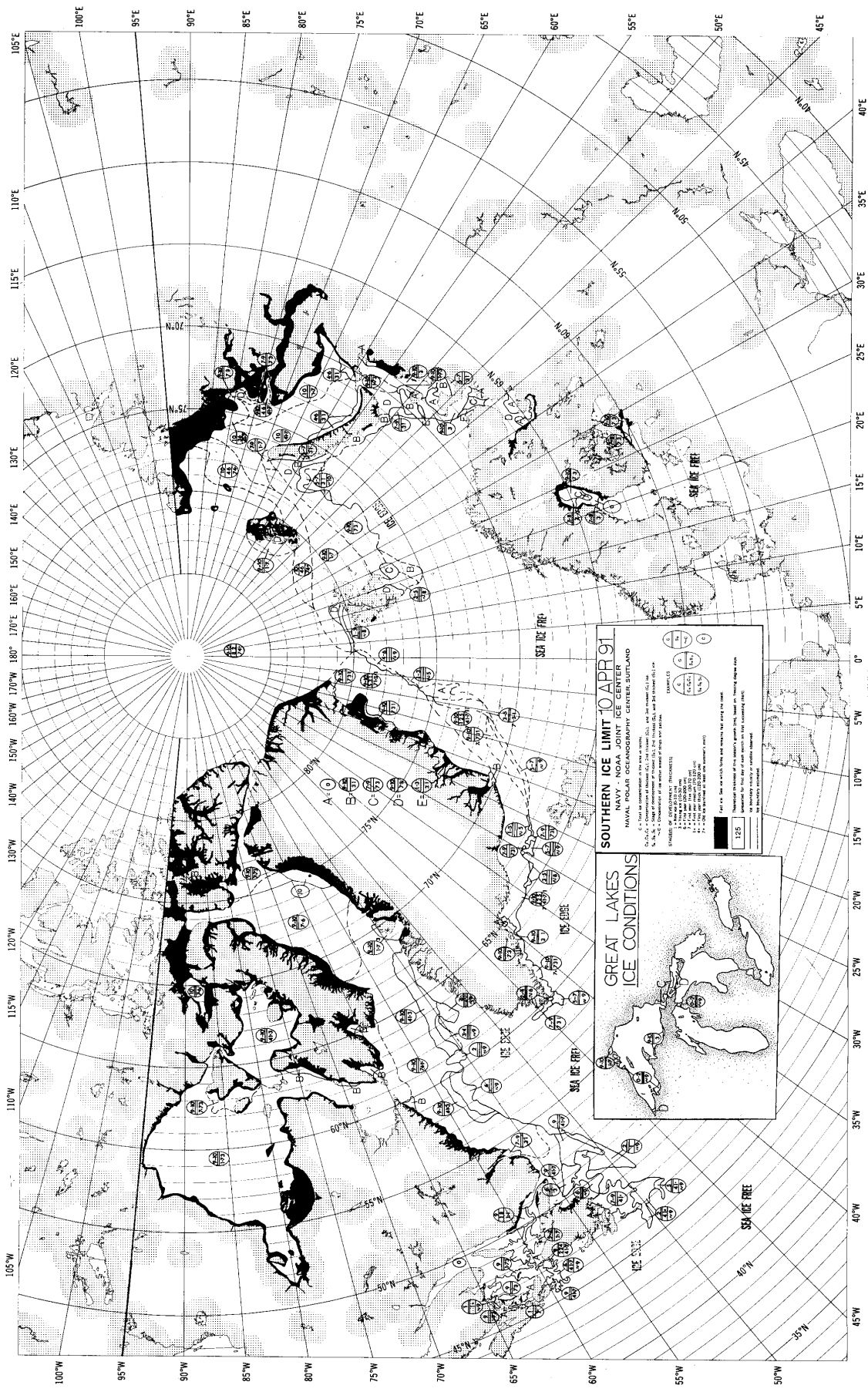
3. The map is based on data from the Naval Polar Oceanography Center, Suitland, and the Naval Oceanographic Office, San Diego. The map shows the ice limit for each of the five Great Lakes: Superior, Michigan, Huron, Erie, and Ontario. The ice limit is shown as a line with various symbols and numbers indicating ice type and thickness. The map is based on data from the Naval Polar Oceanography Center, Suitland, and the Naval Oceanographic Office, San Diego.

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SOUTHERN ICE LIMIT 10 APR 91
NAVY - NOAA JOINT ICE CENTER BUTLAND

1. Year of observation in the first column.
2. Latitude and longitude of observation in the second column.
3. Ice type (see legend for details).
4. Ice concentration (see legend for details).
5. Ice thickness (see legend for details).
6. Ice motion (see legend for details).
7. Ice motion direction (see legend for details).
8. Ice motion speed (see legend for details).
9. Ice motion direction and speed (see legend for details).
10. Ice motion direction and speed (see legend for details).

EXAMPLE 1: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

EXAMPLE 2: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

EXAMPLE 3: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

EXAMPLE 4: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

EXAMPLE 5: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

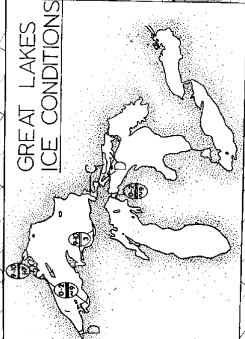
EXAMPLE 6: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

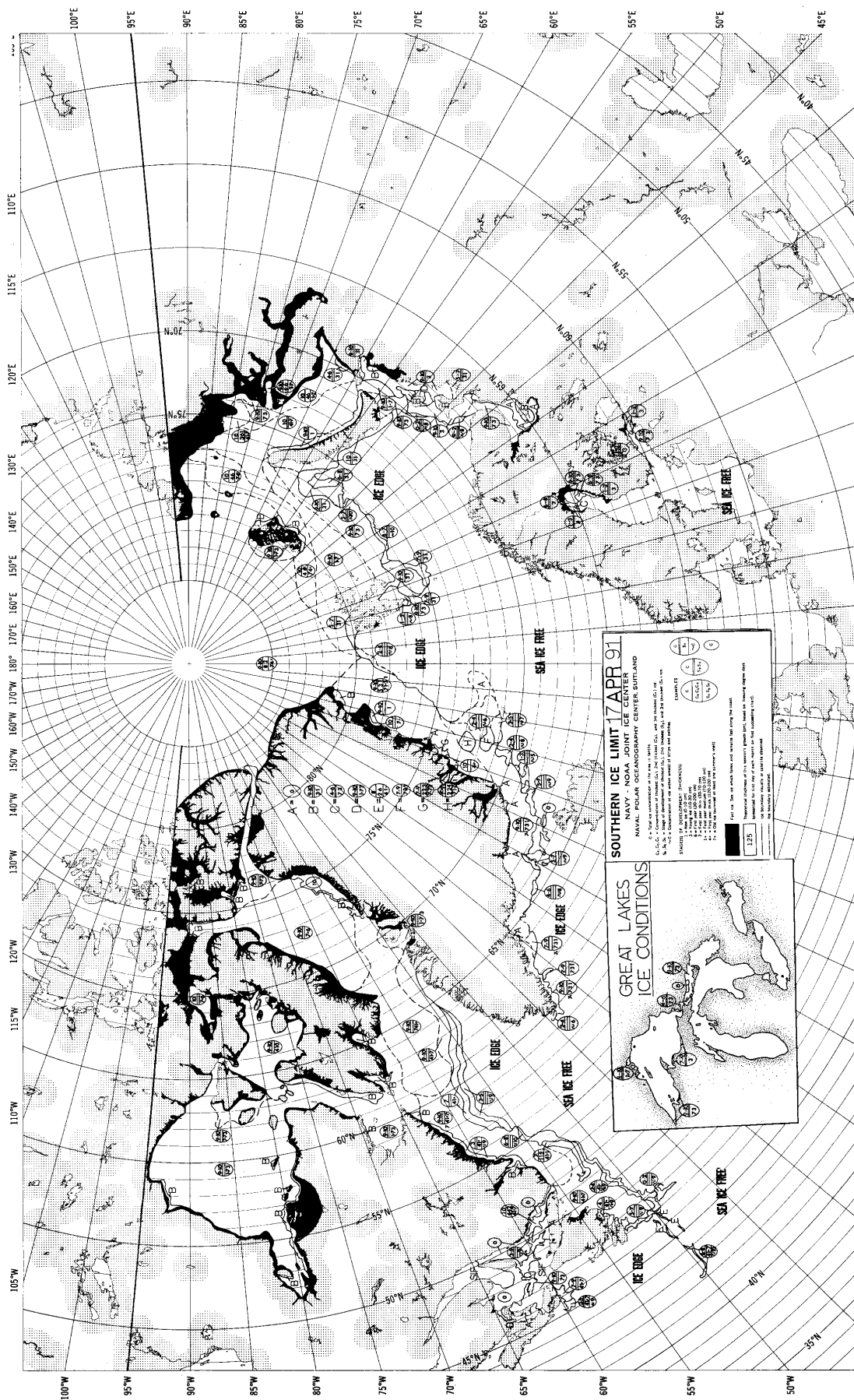
EXAMPLE 7: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

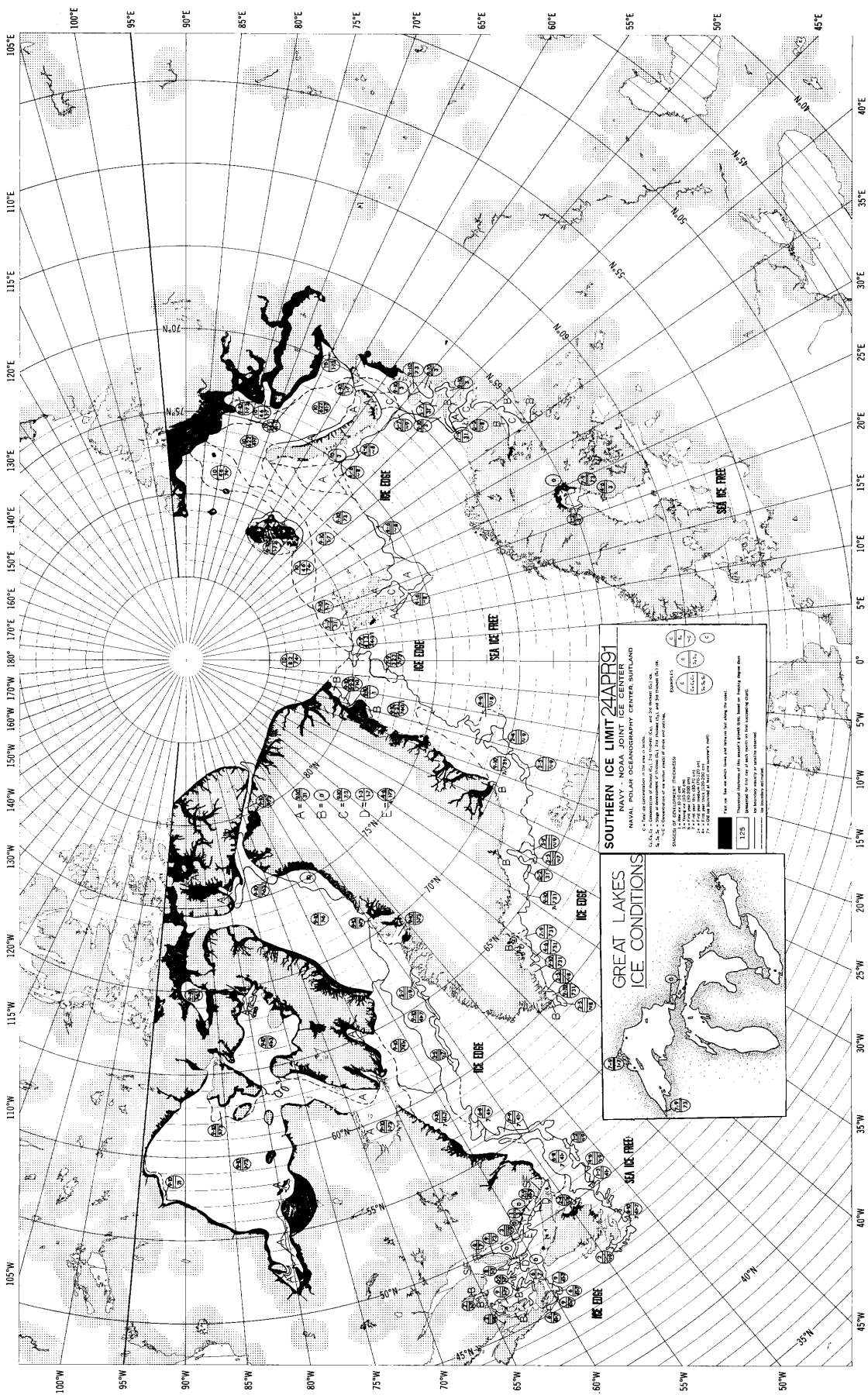
EXAMPLE 8: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

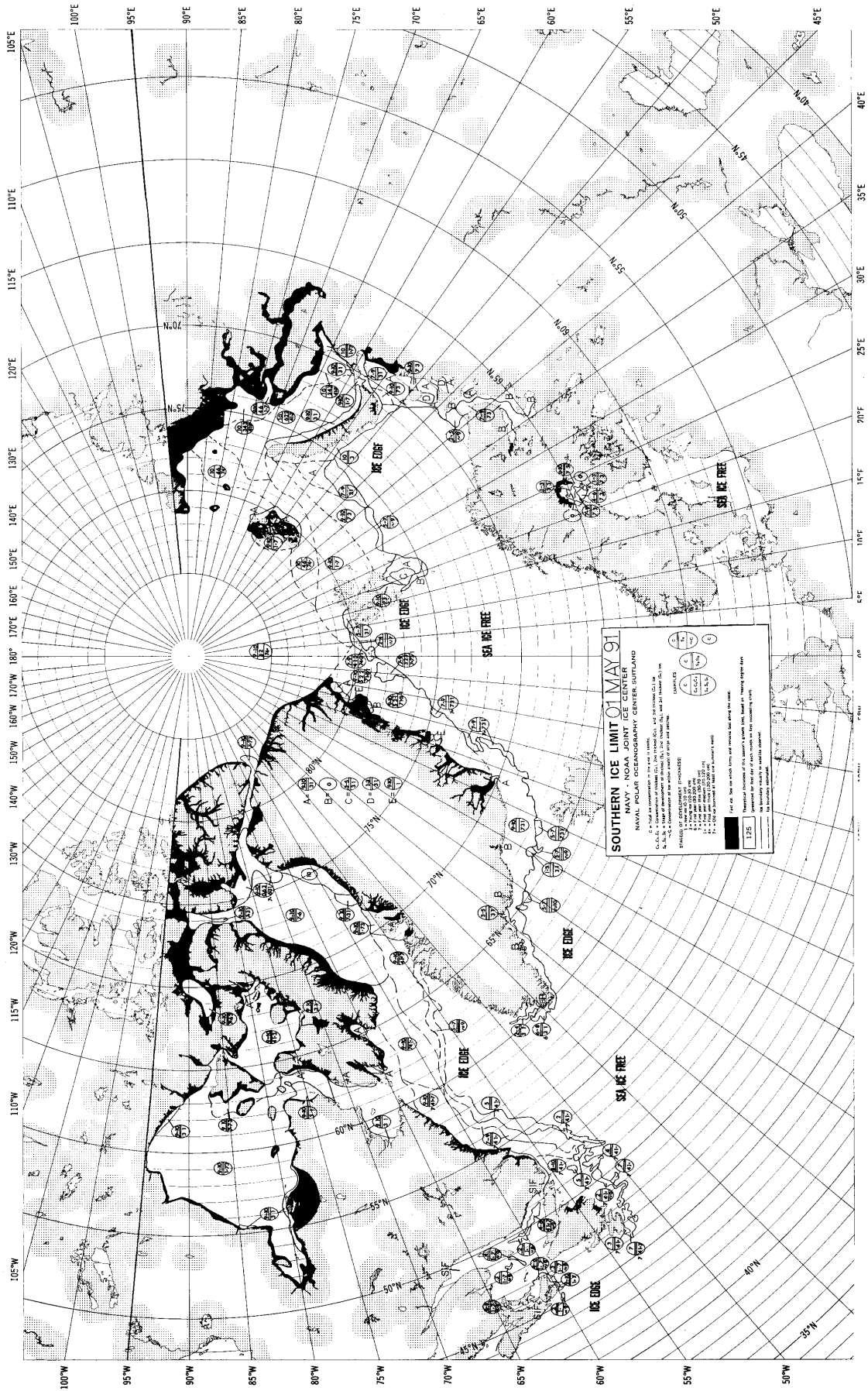
EXAMPLE 9: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

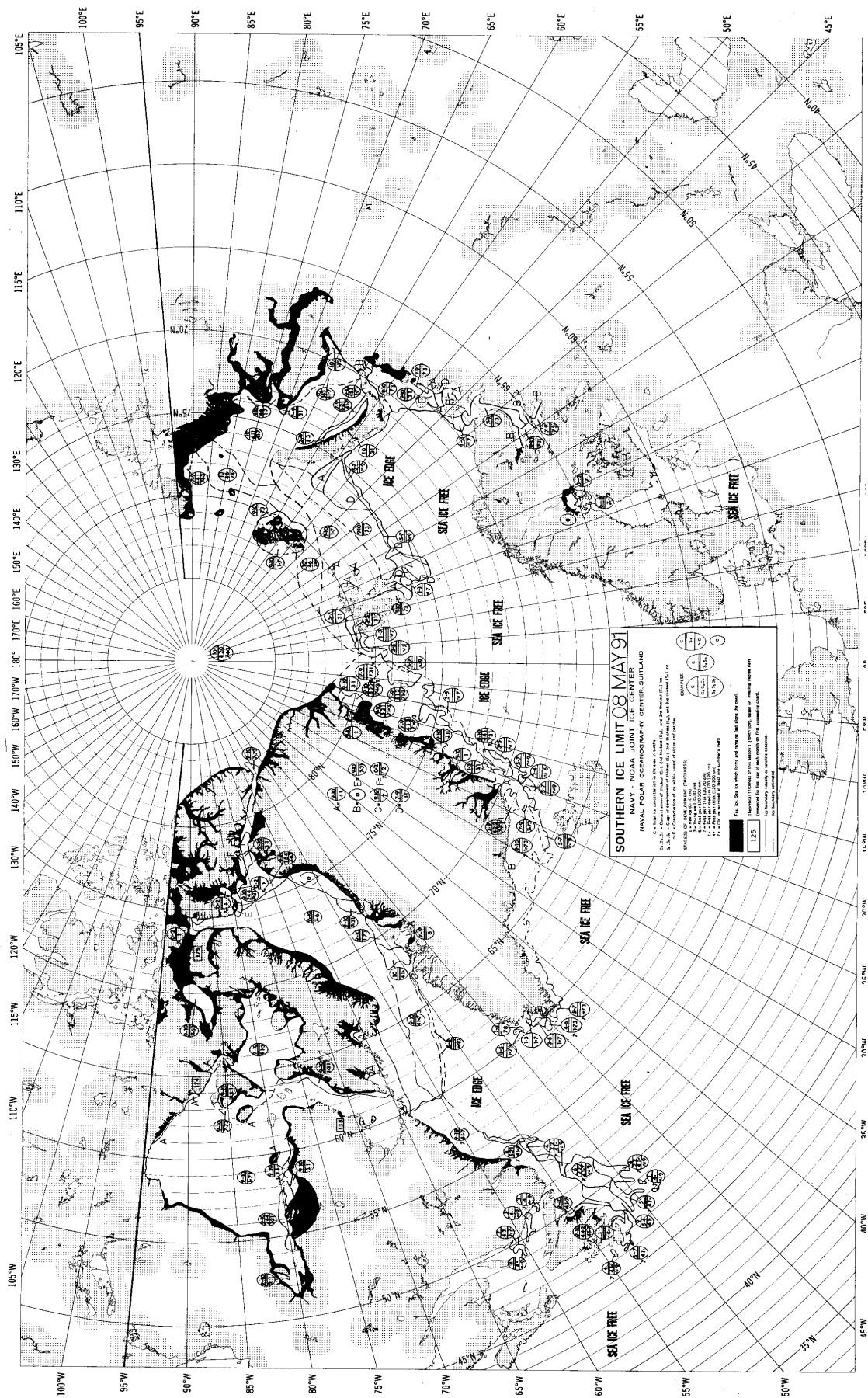
EXAMPLE 10: 1991 75N 150W 100 100 100 100 100 100 100 100 100 100

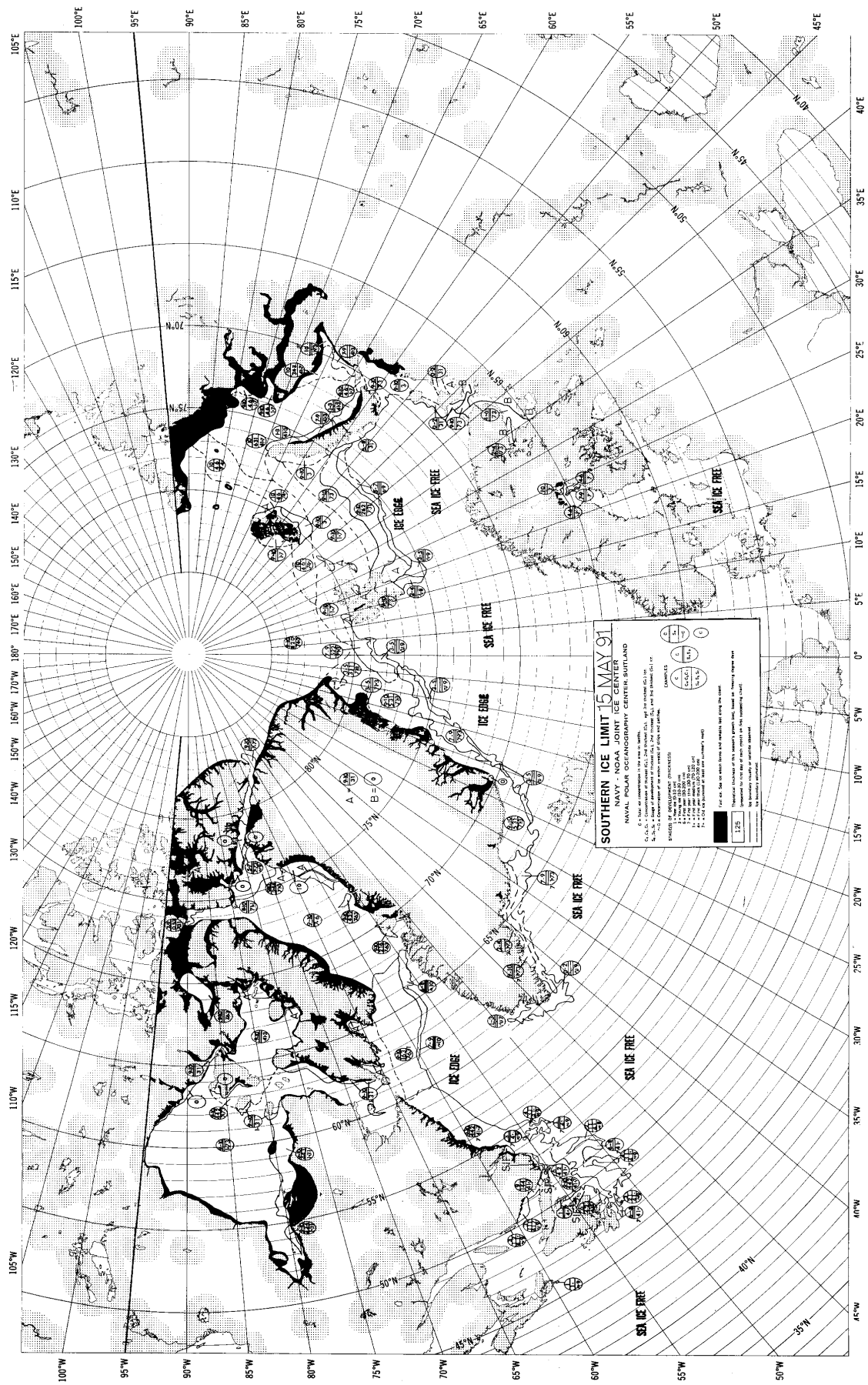


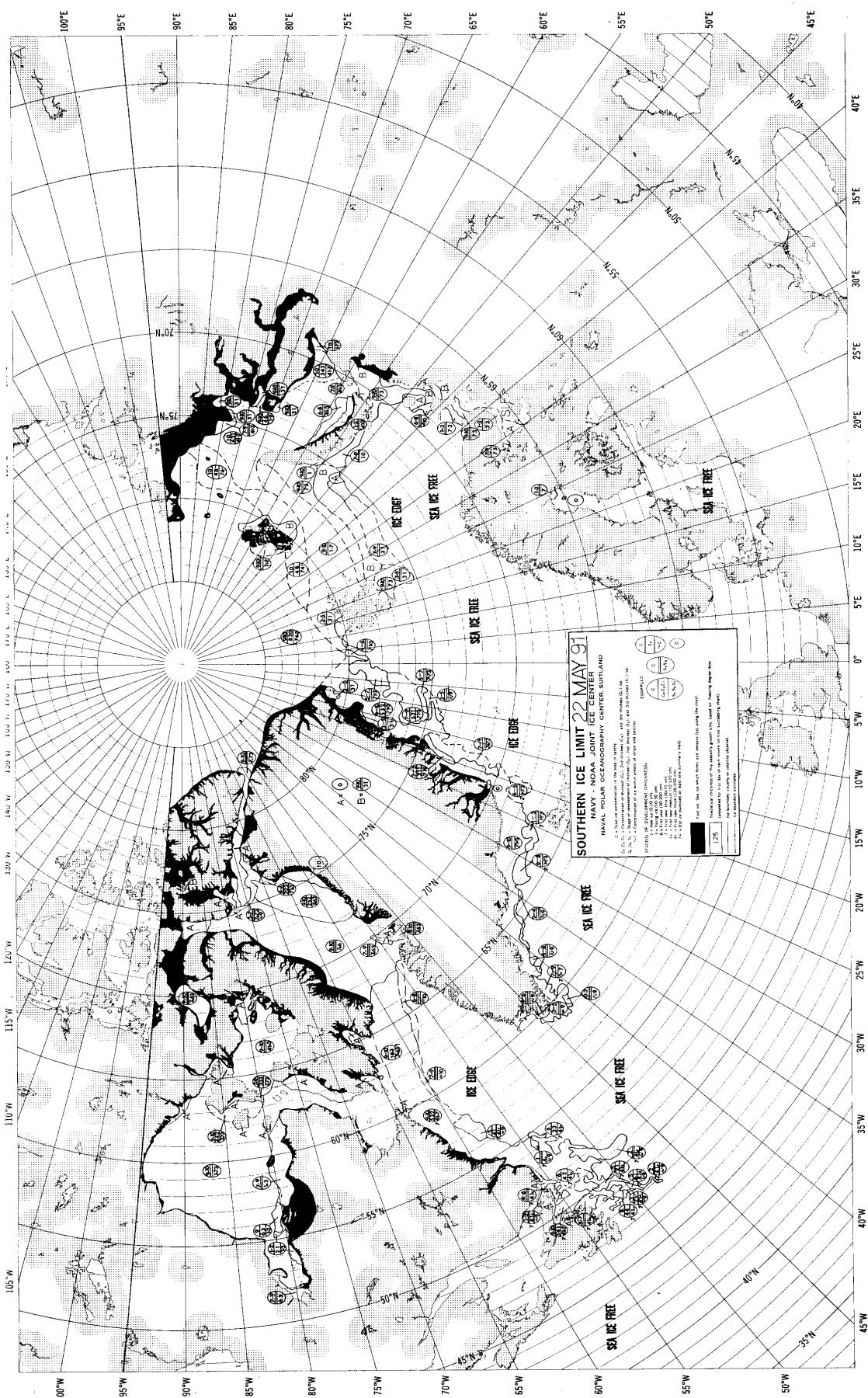


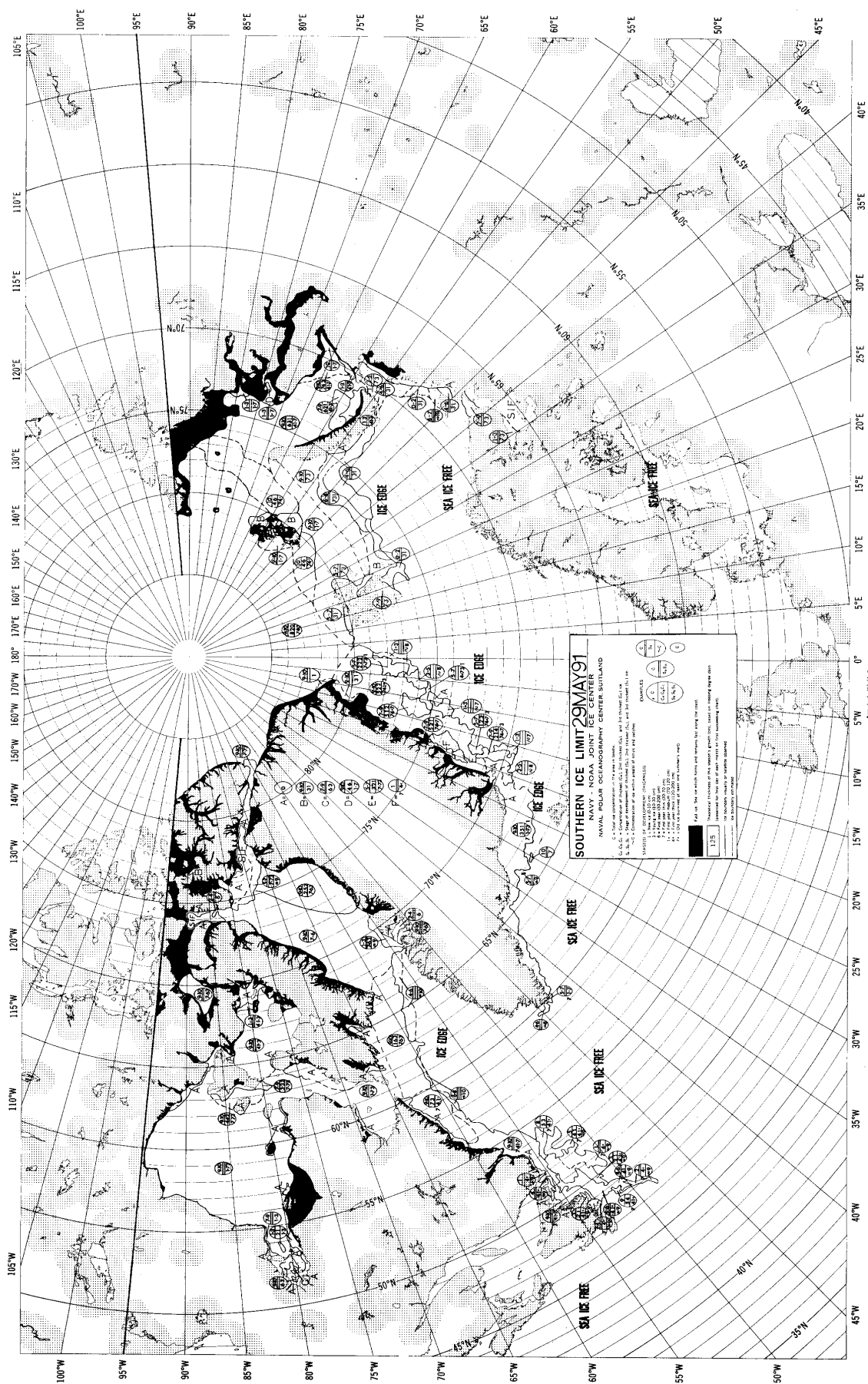


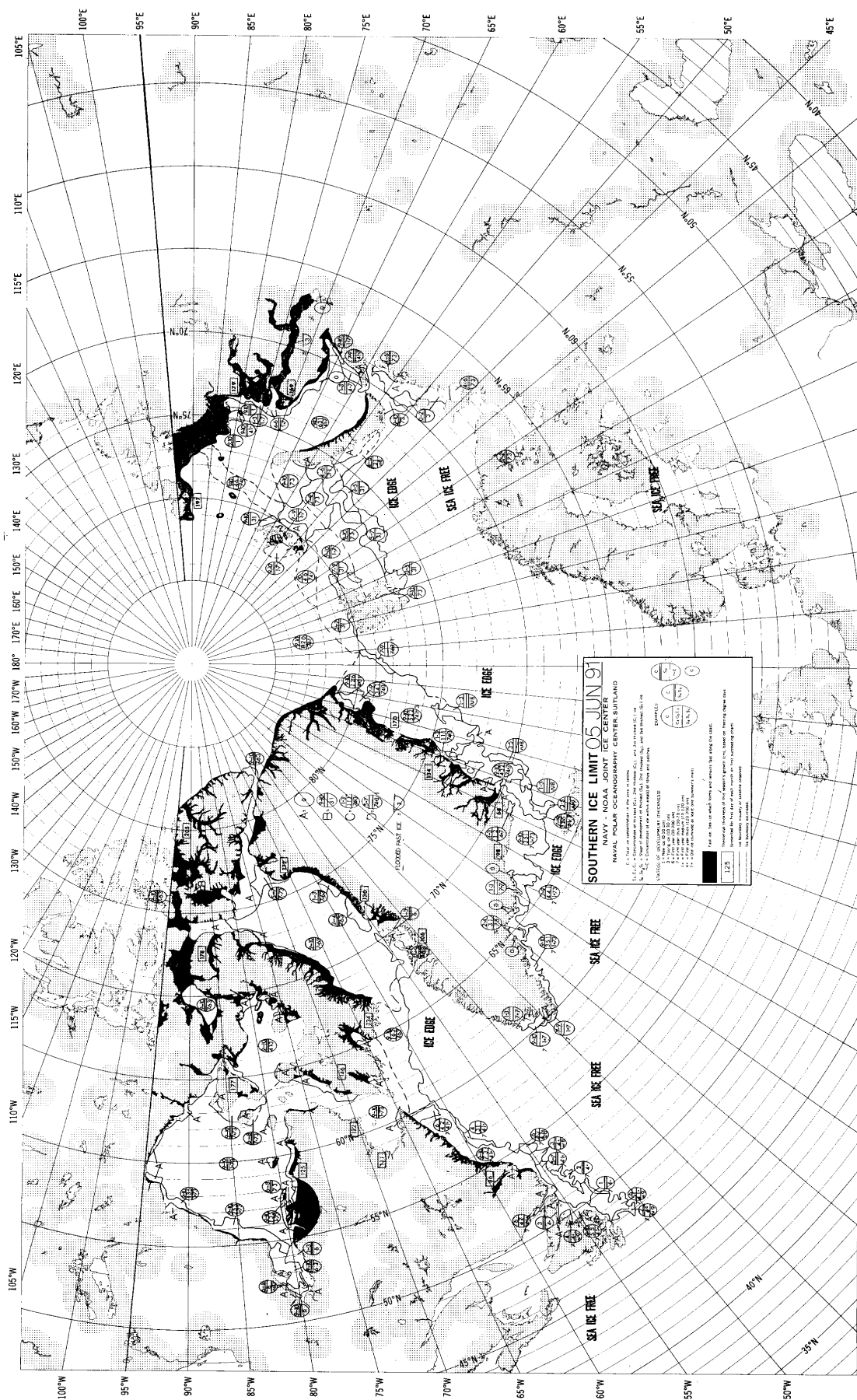


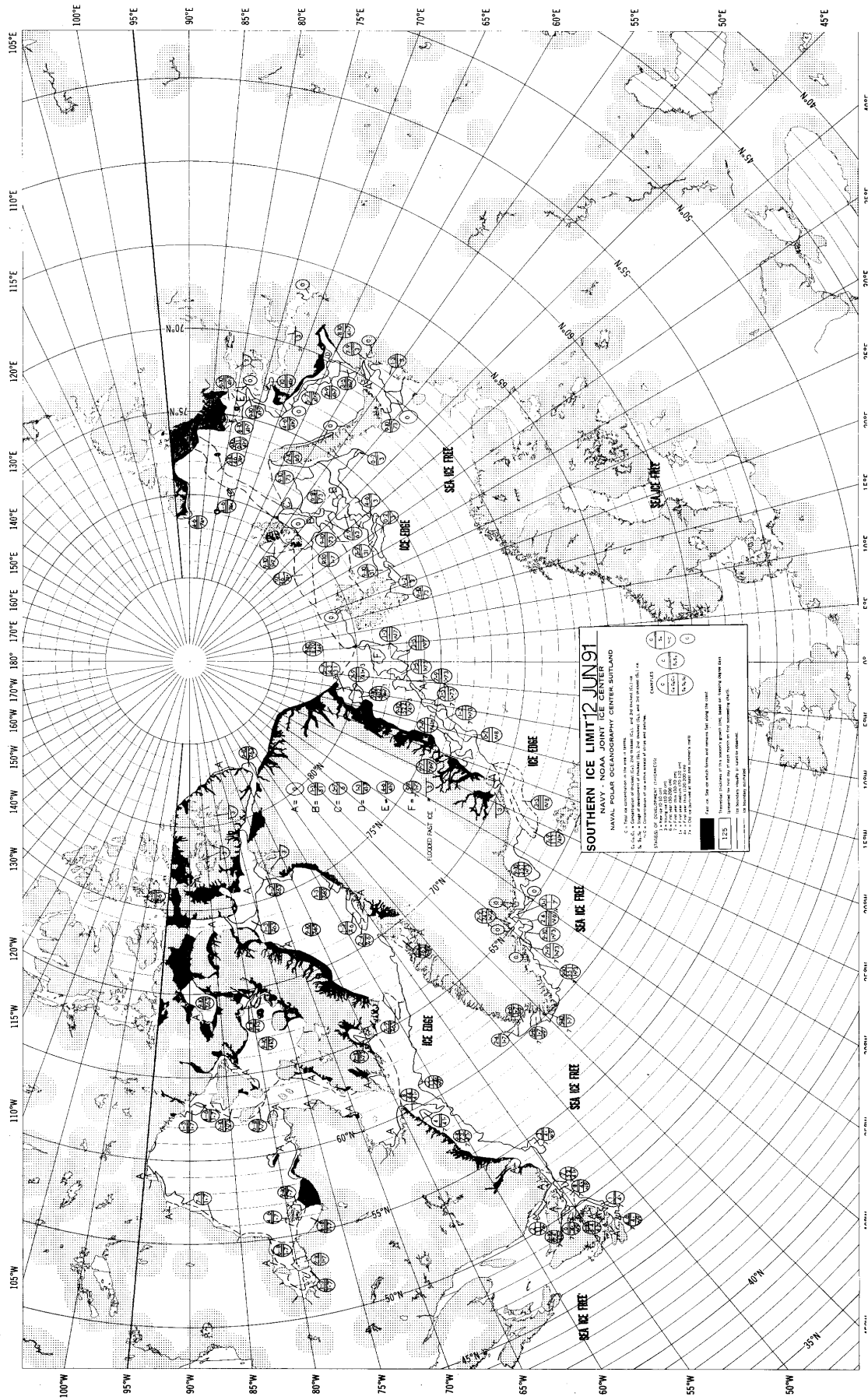


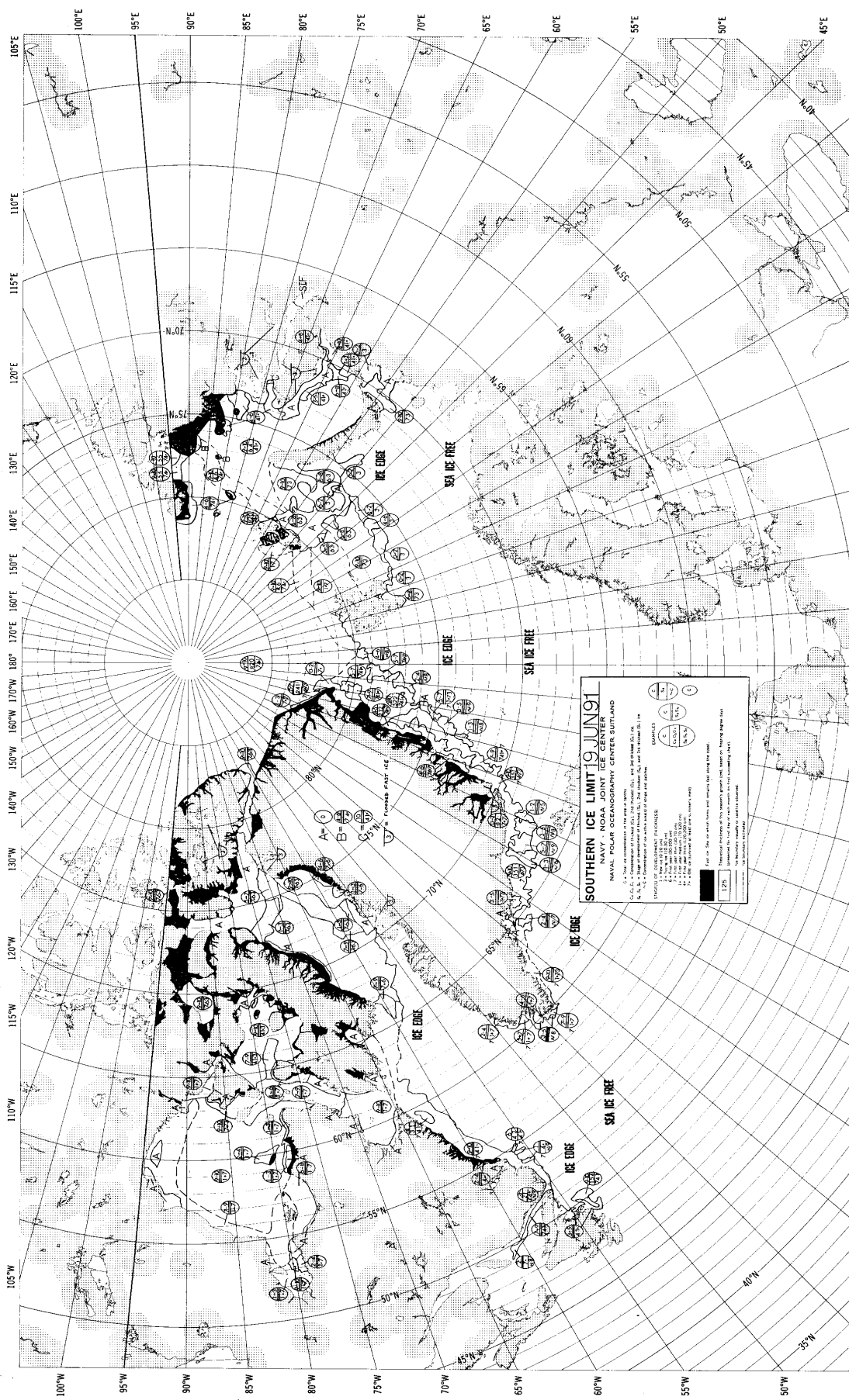


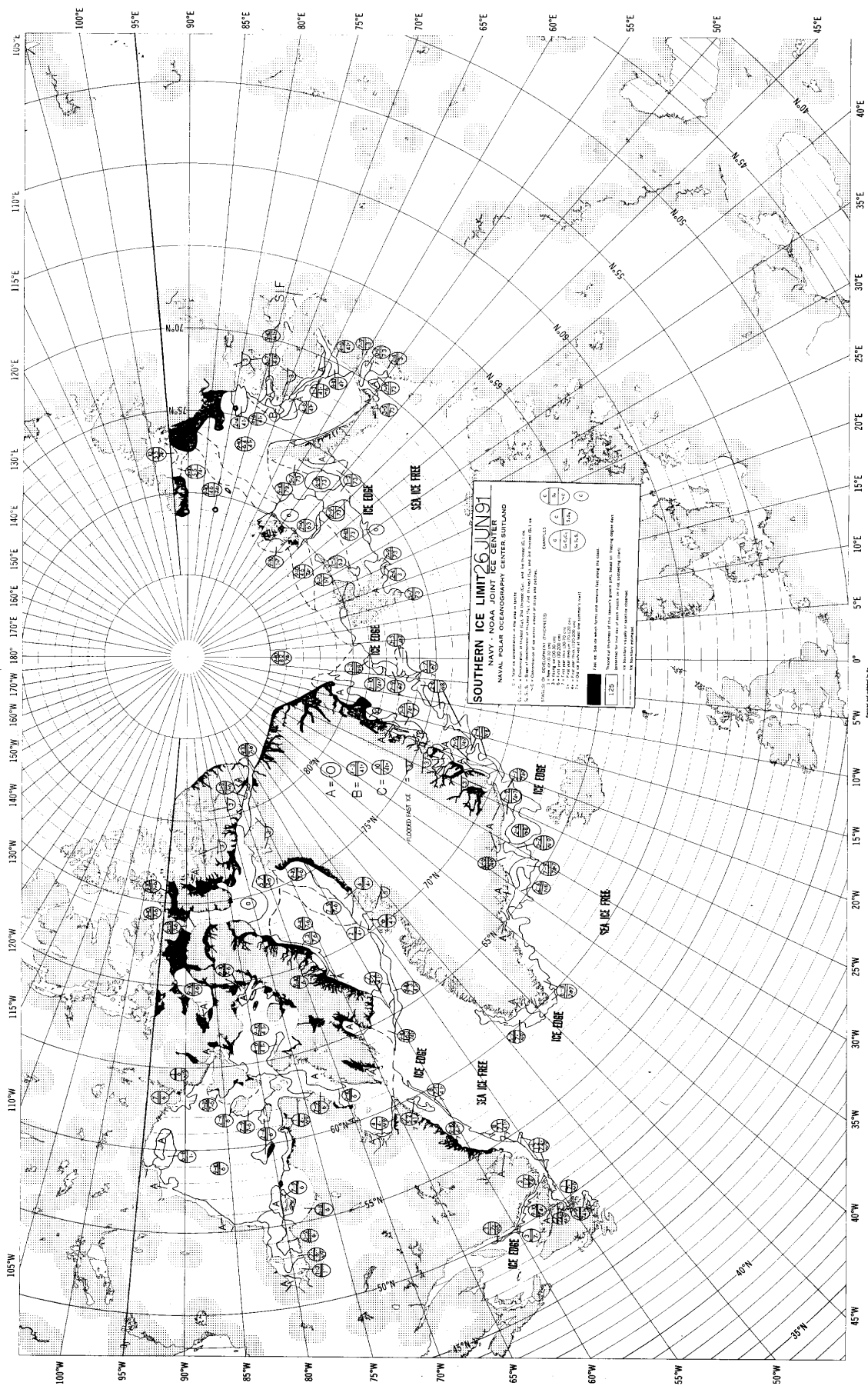


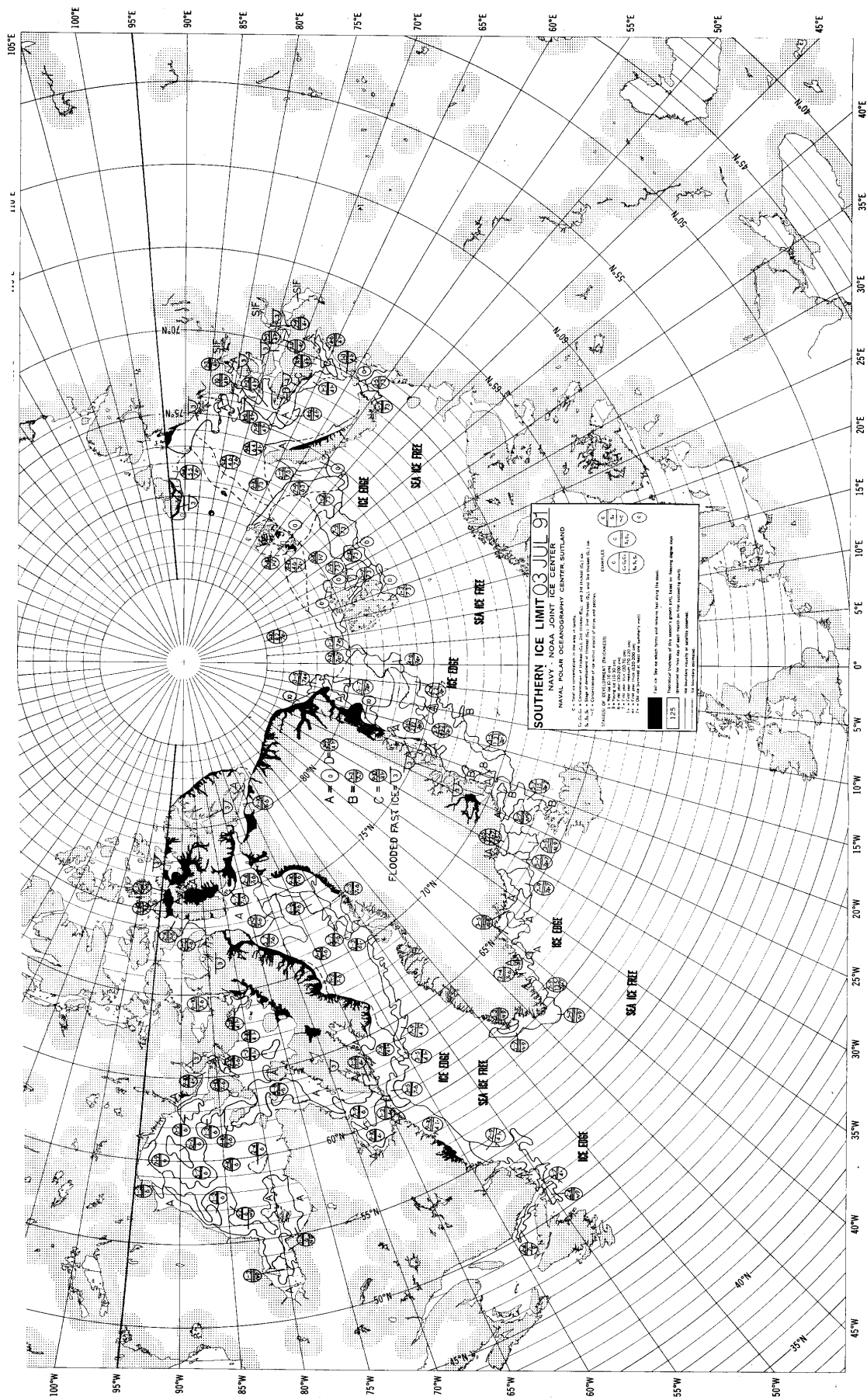


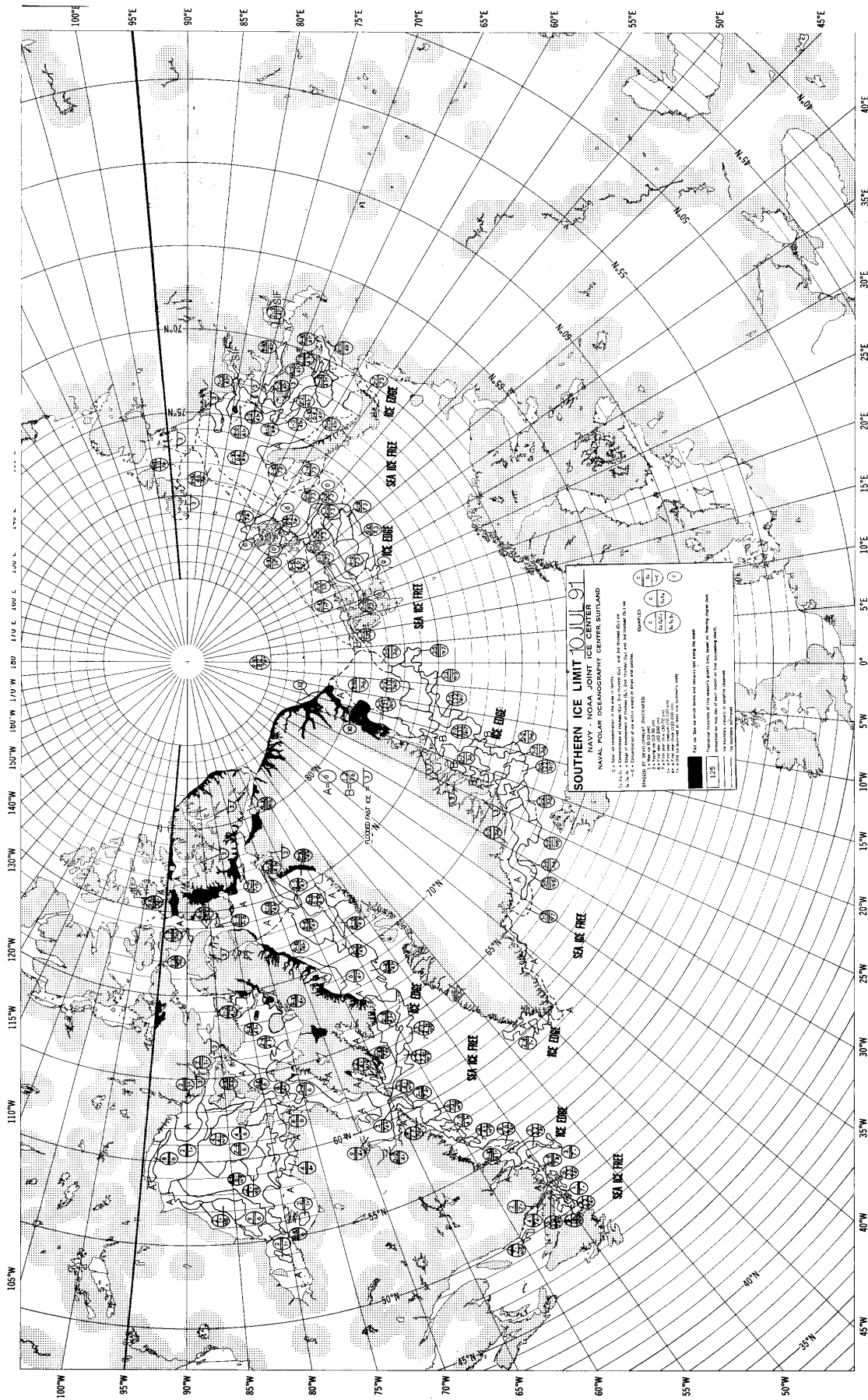


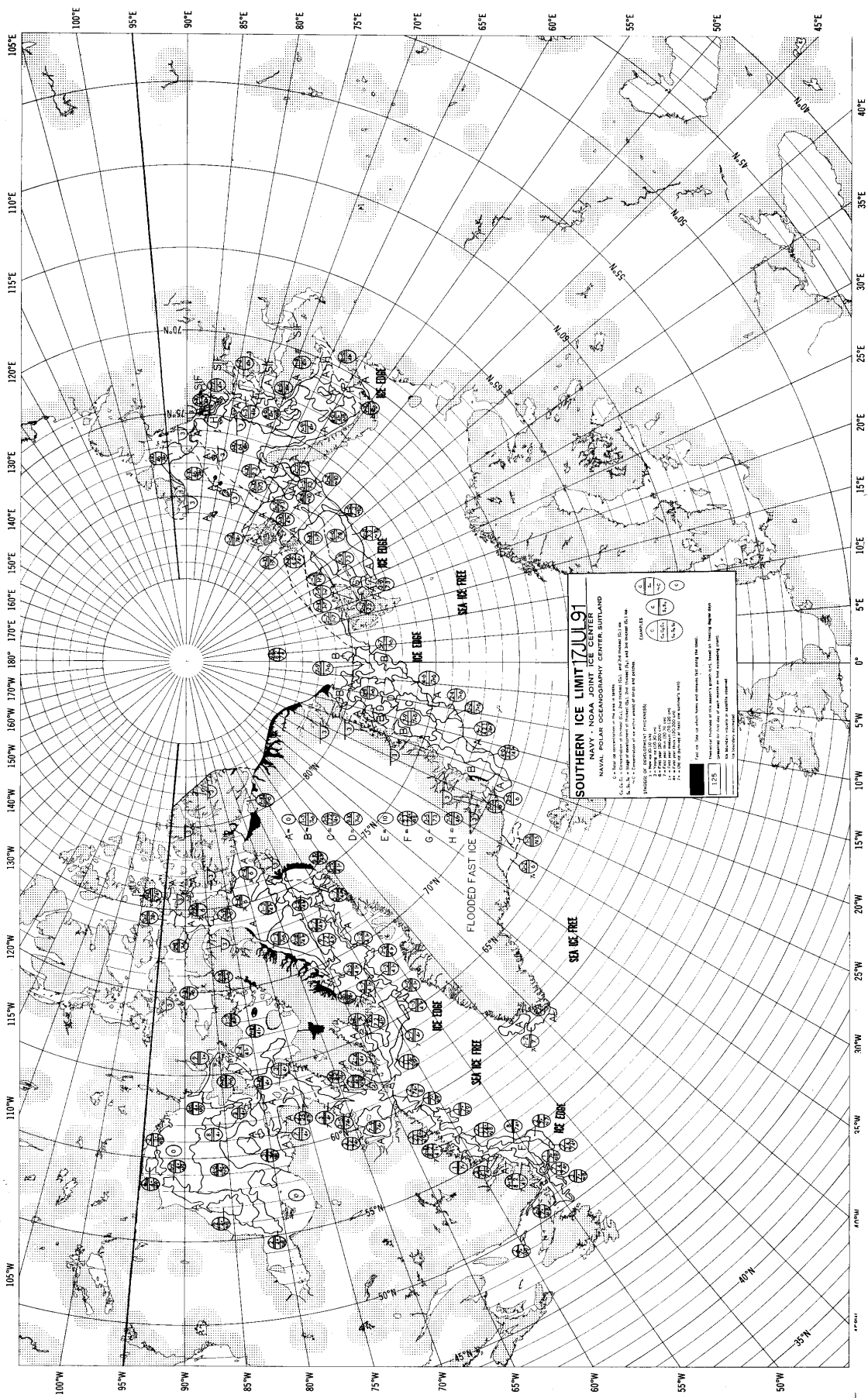


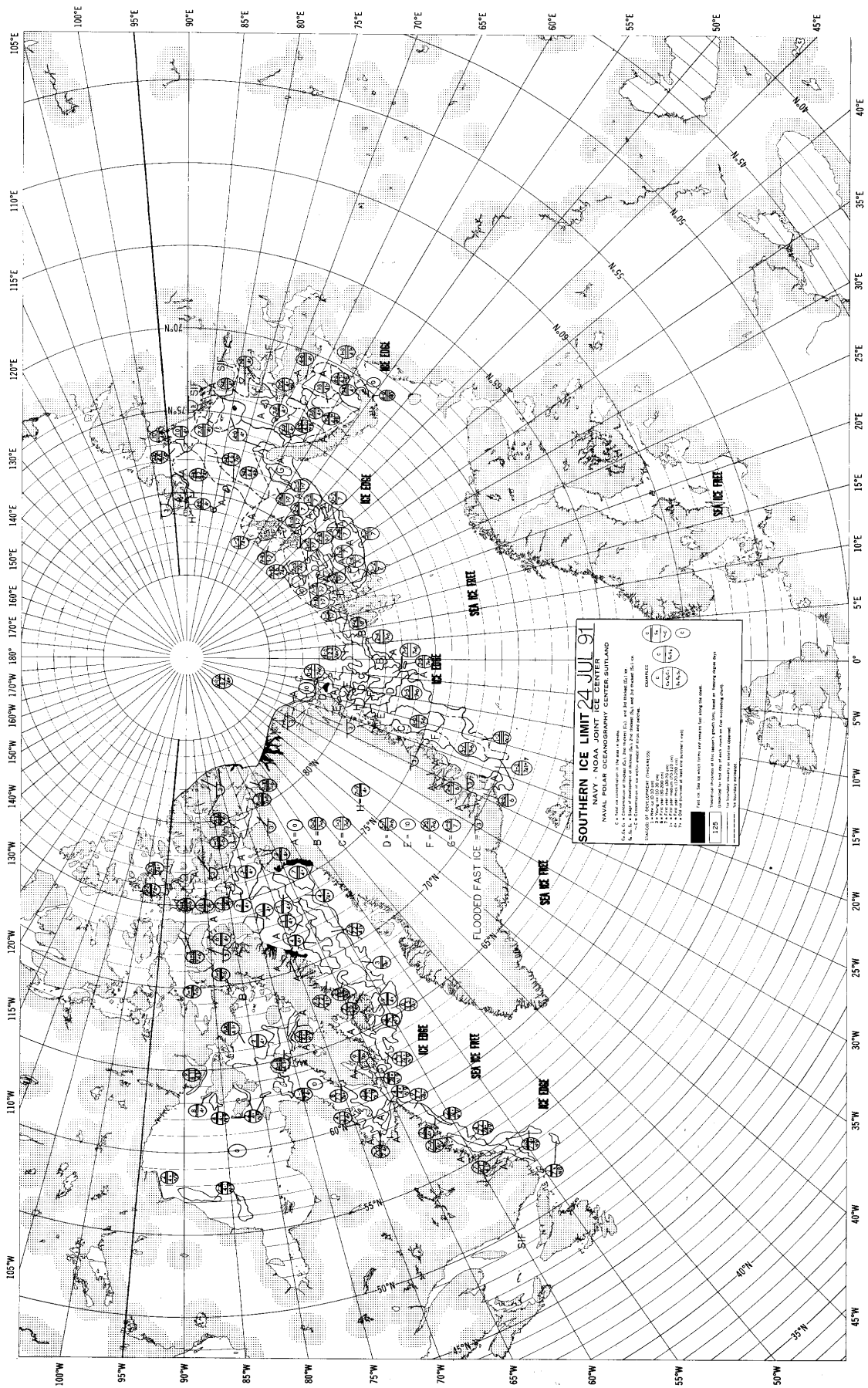


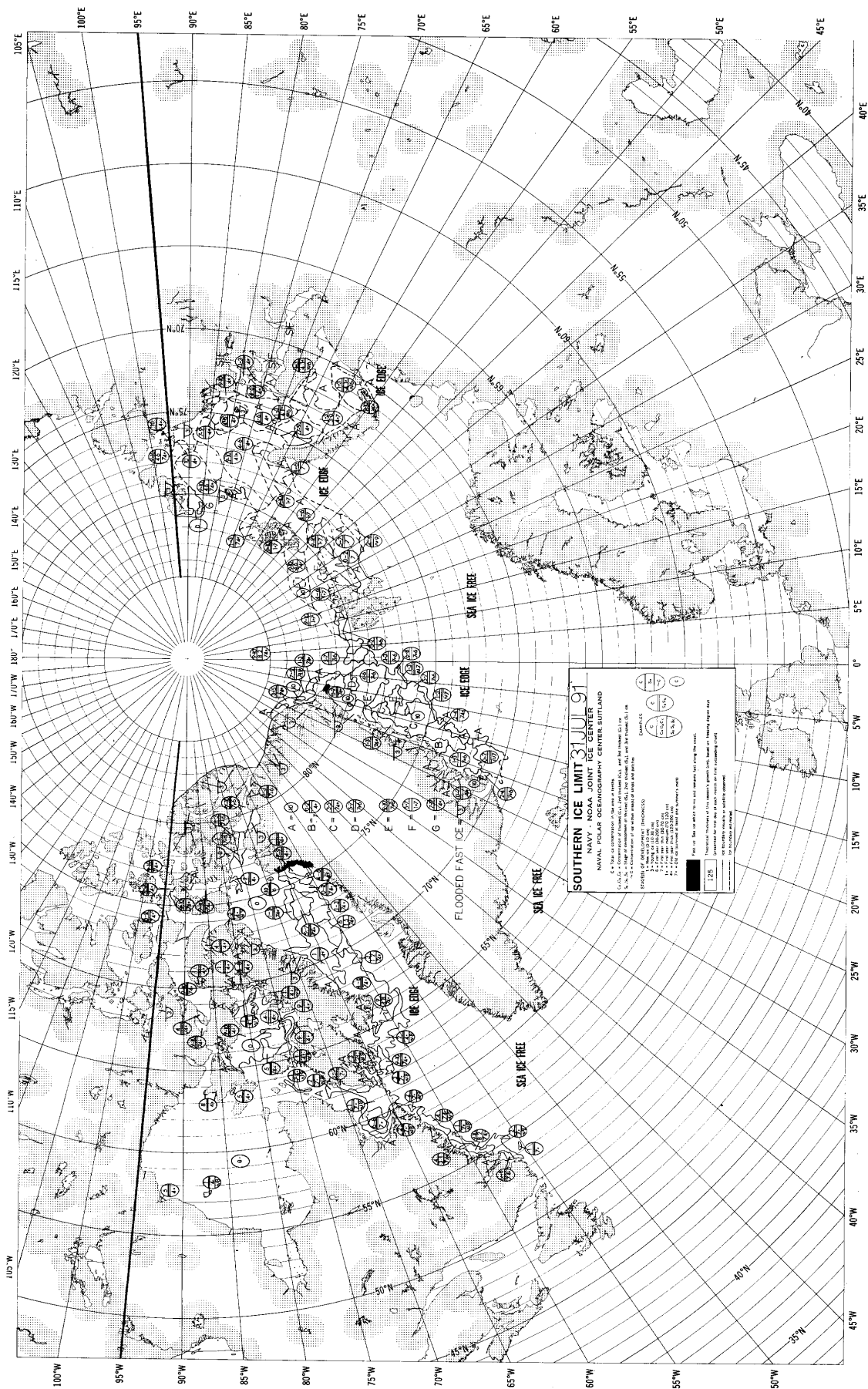


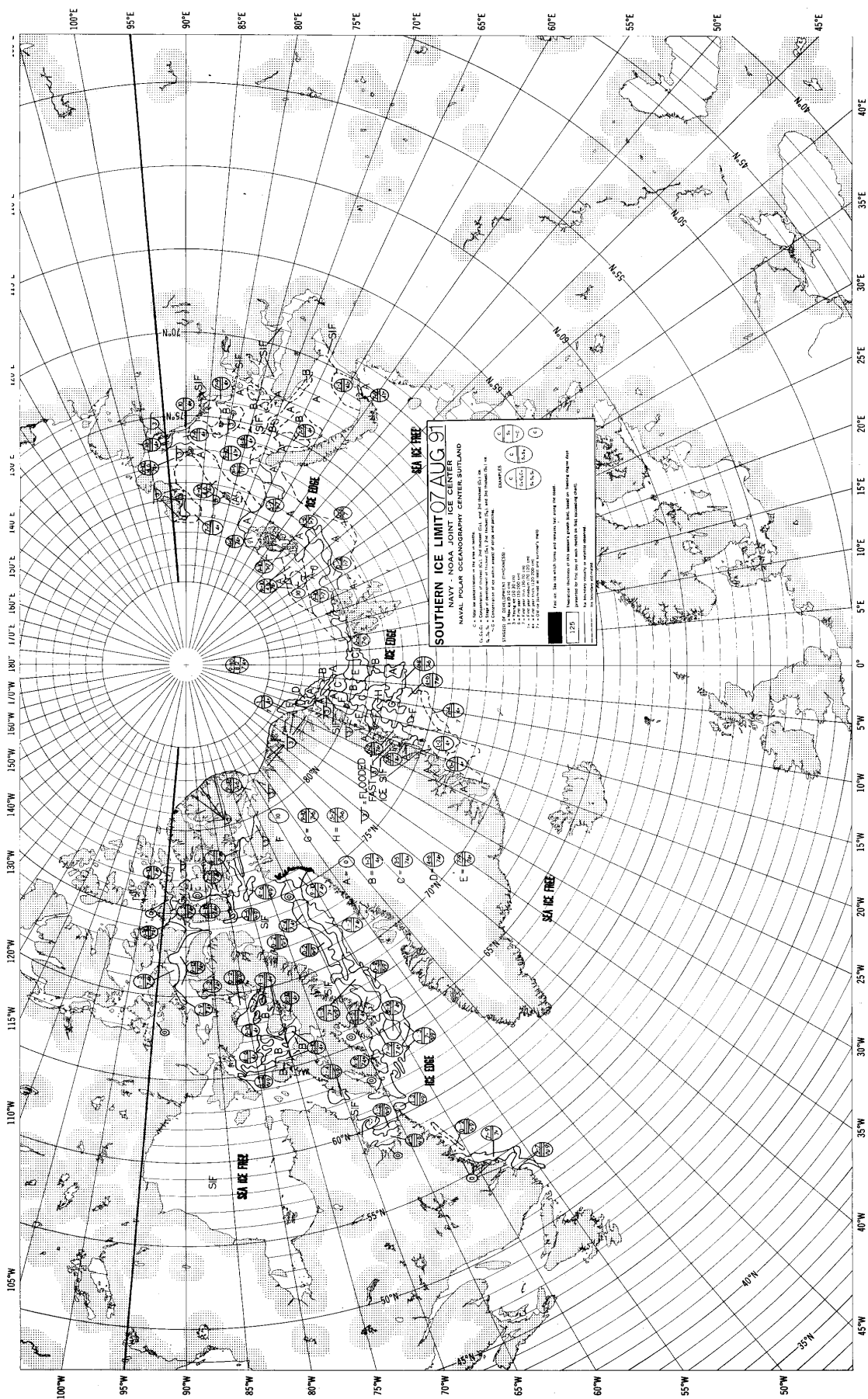


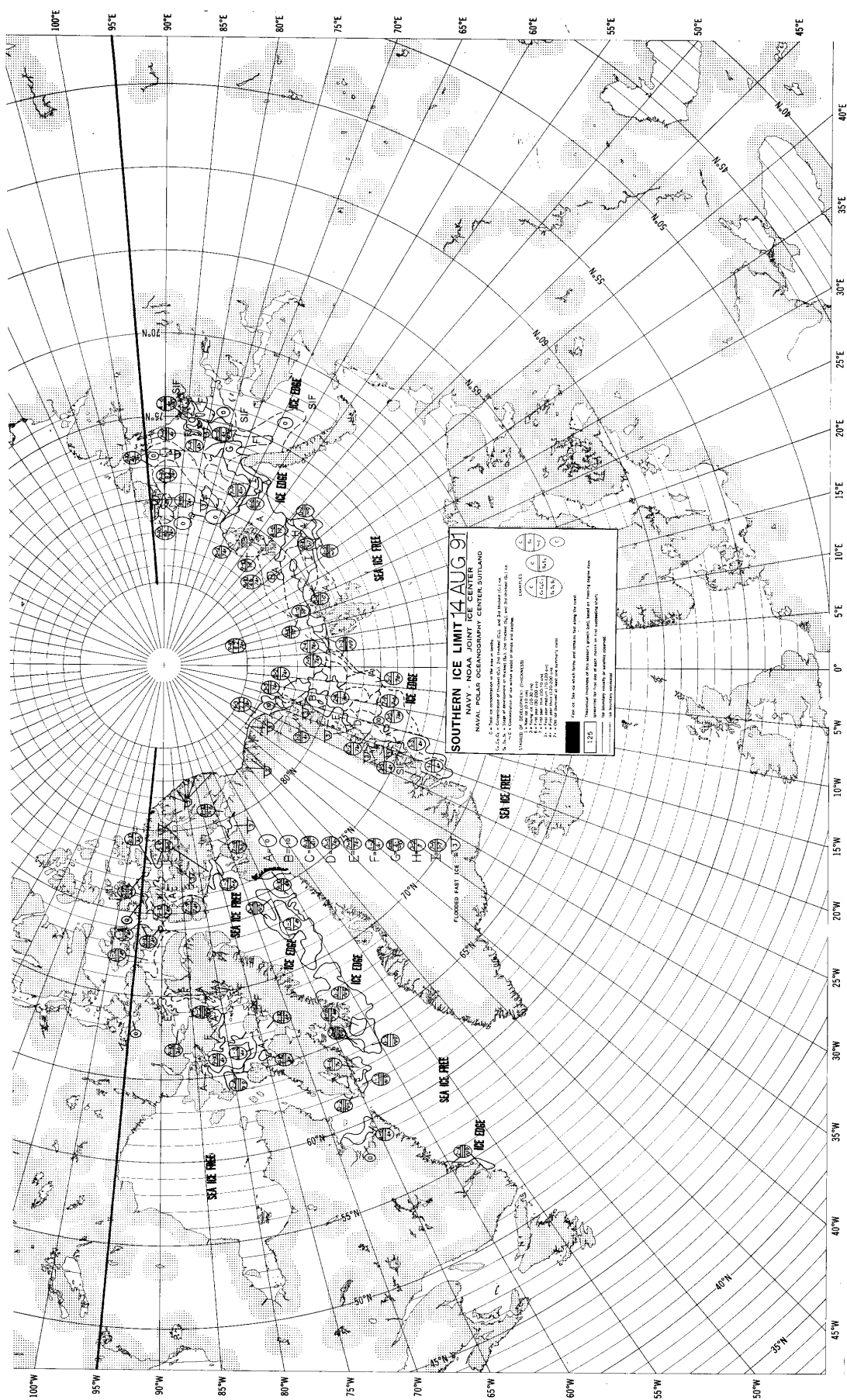


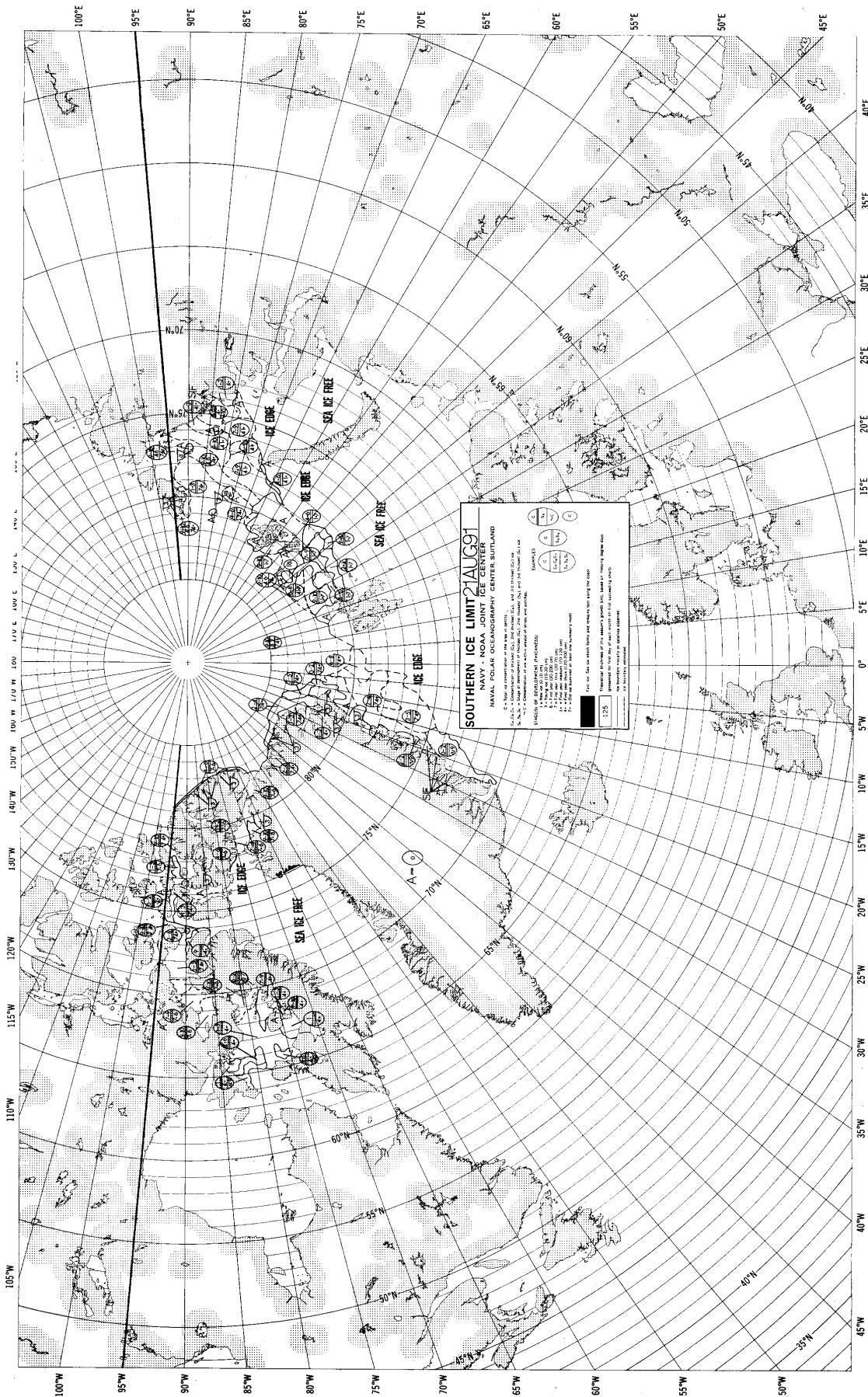


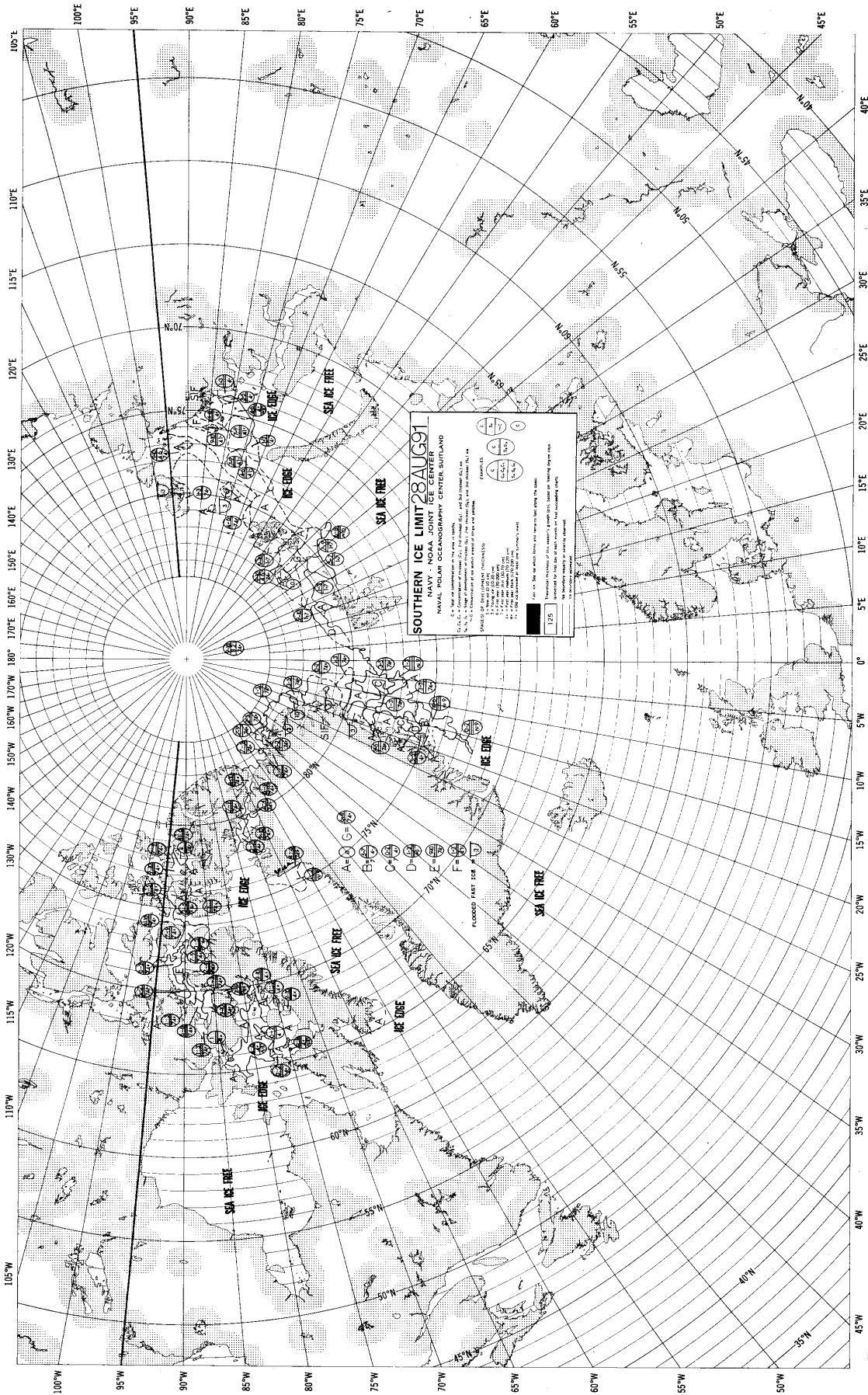


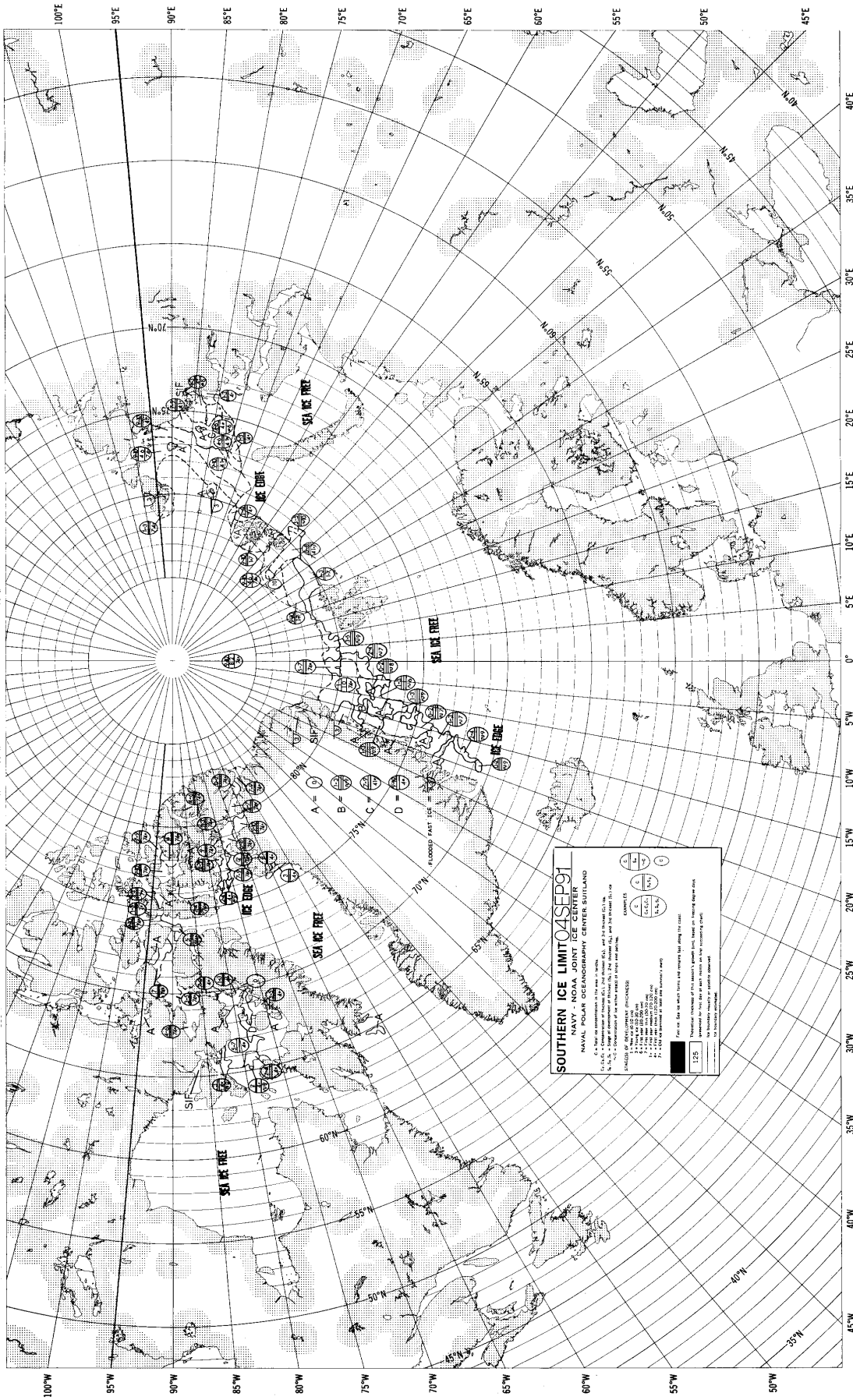












SOUTHERN ICE LIMIT 04 SEP 01
NAVY POLAR OCEANOGRAPHY CENTER
NAVY POLAR OCEANOGRAPHY CENTER, STATION 125

1. This map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

2. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

3. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

4. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

5. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

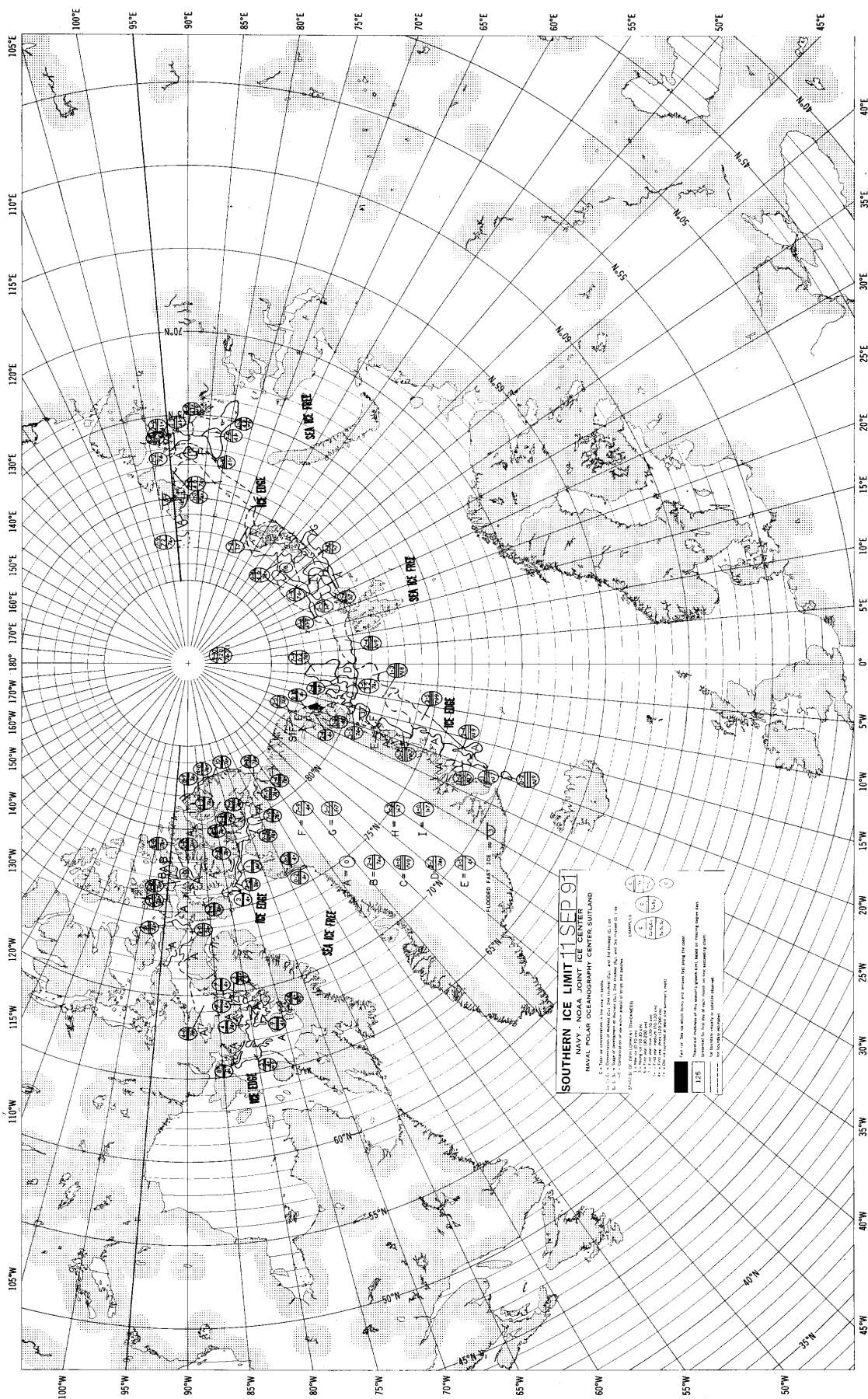
6. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

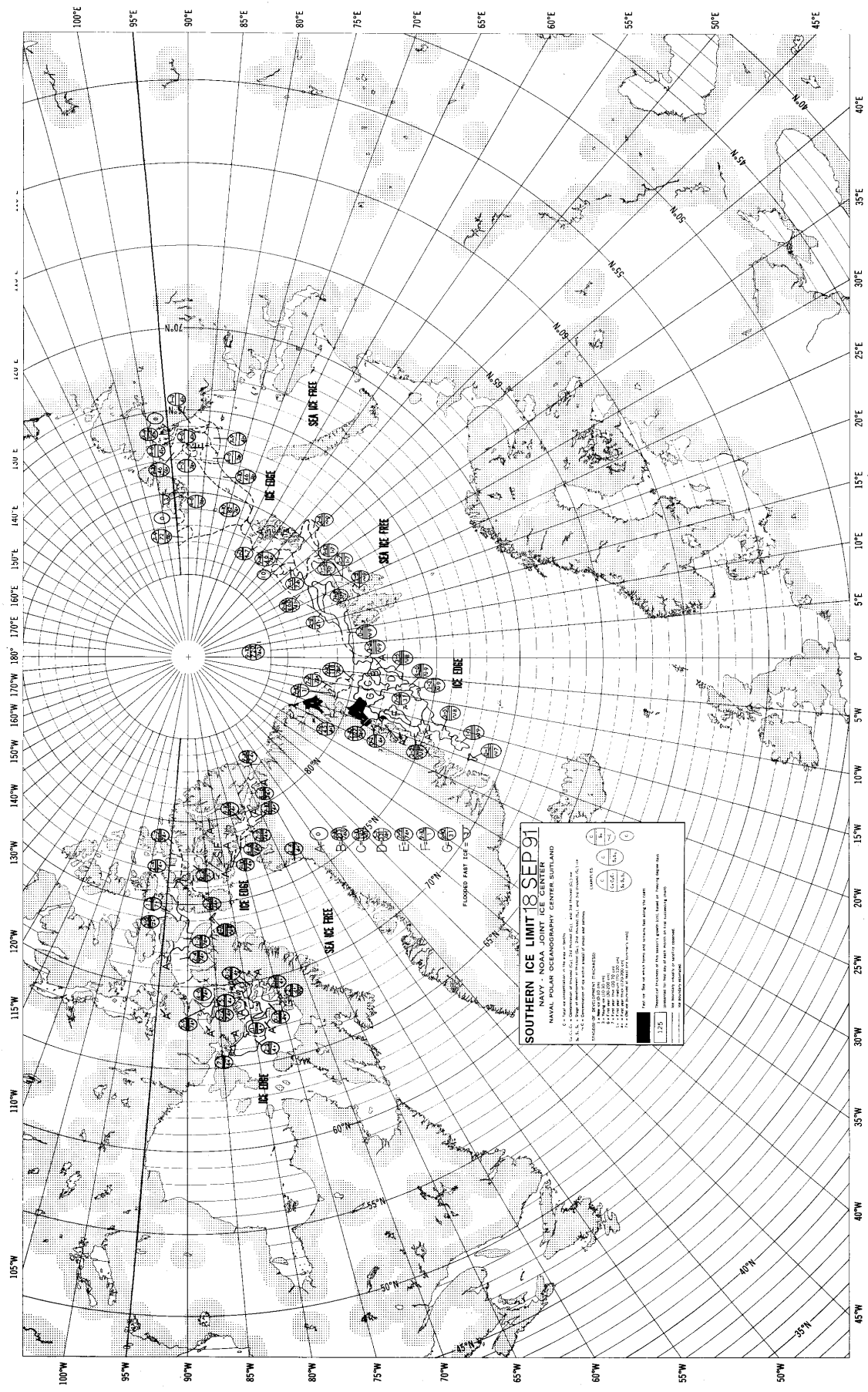
7. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

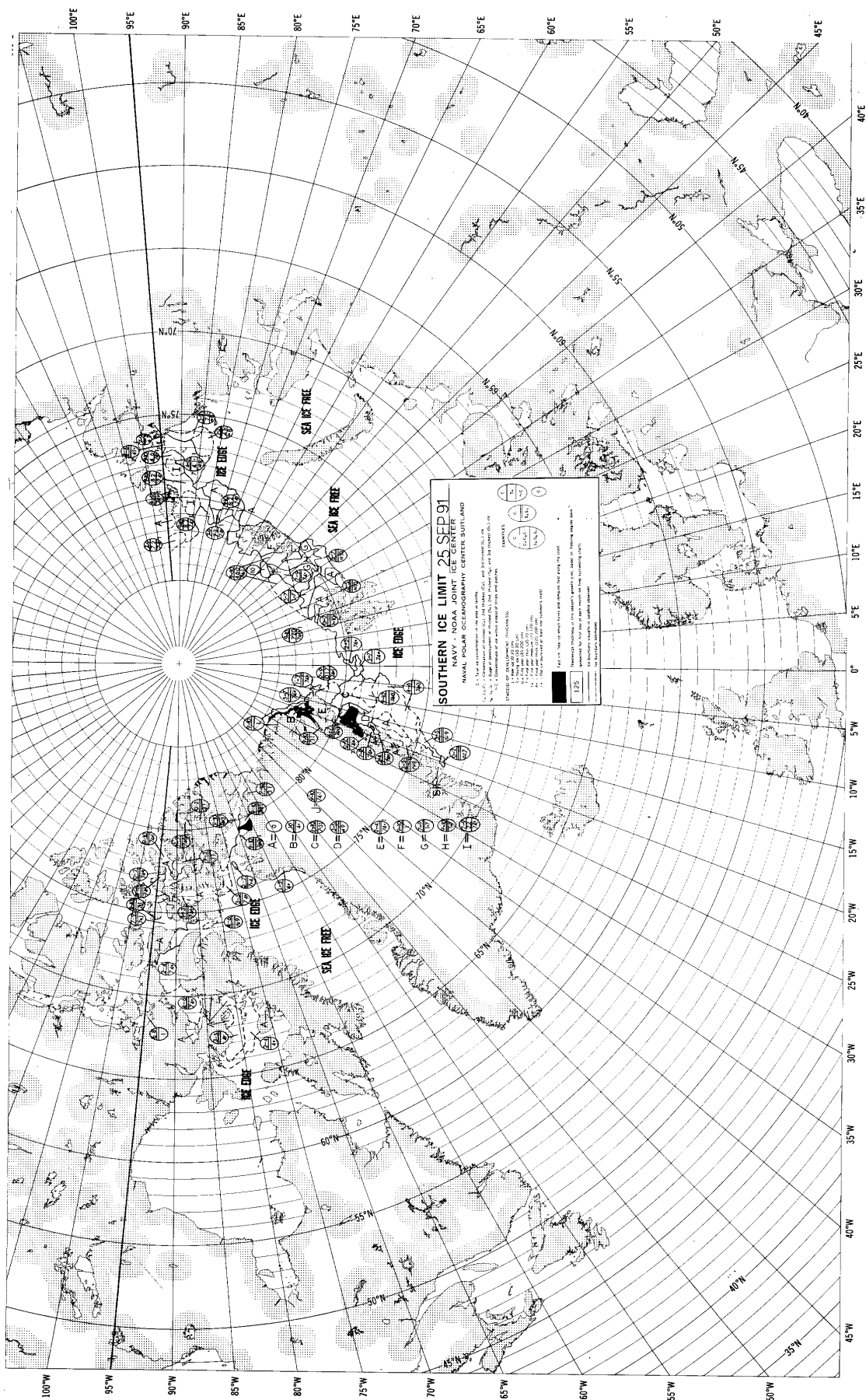
8. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

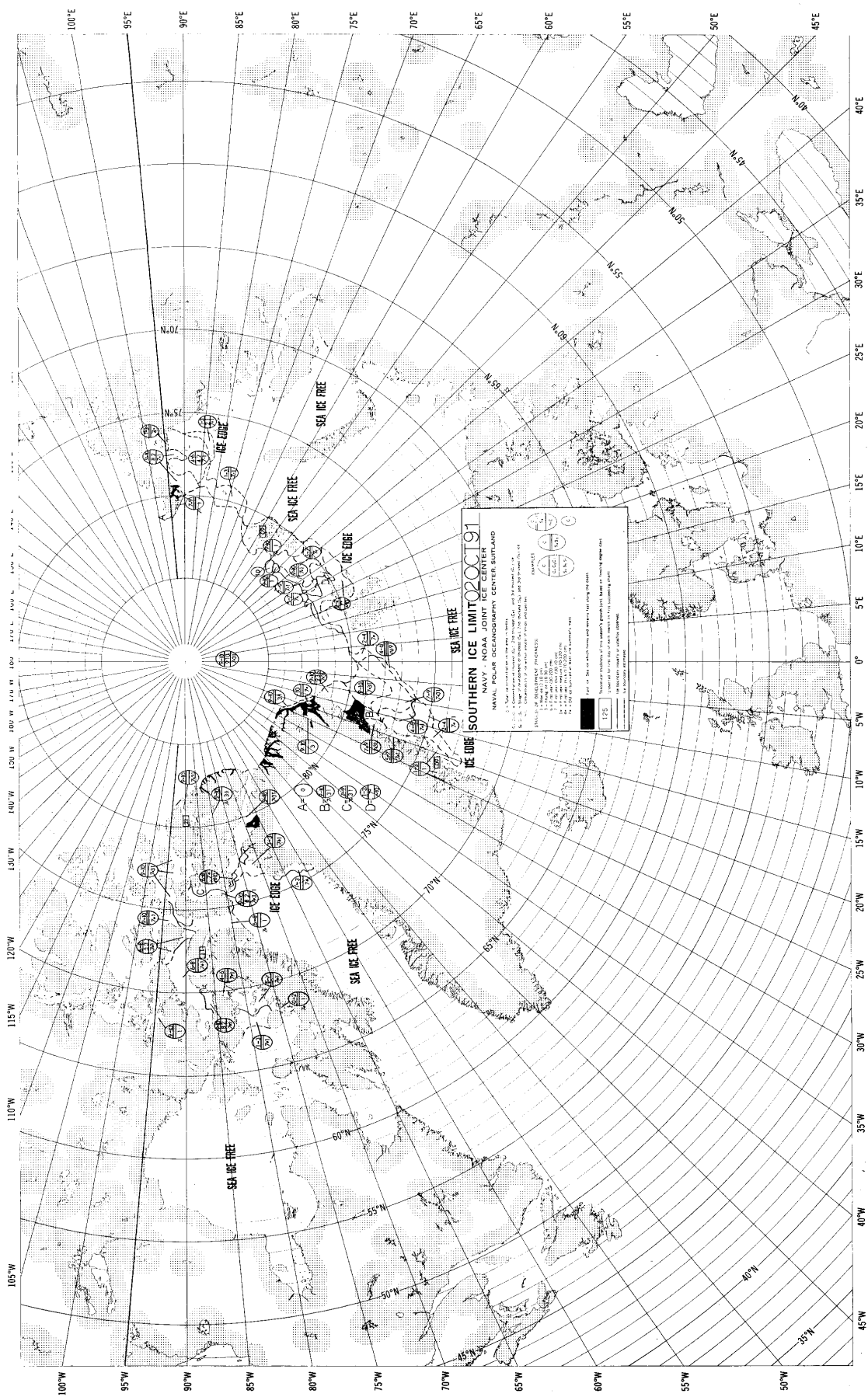
9. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

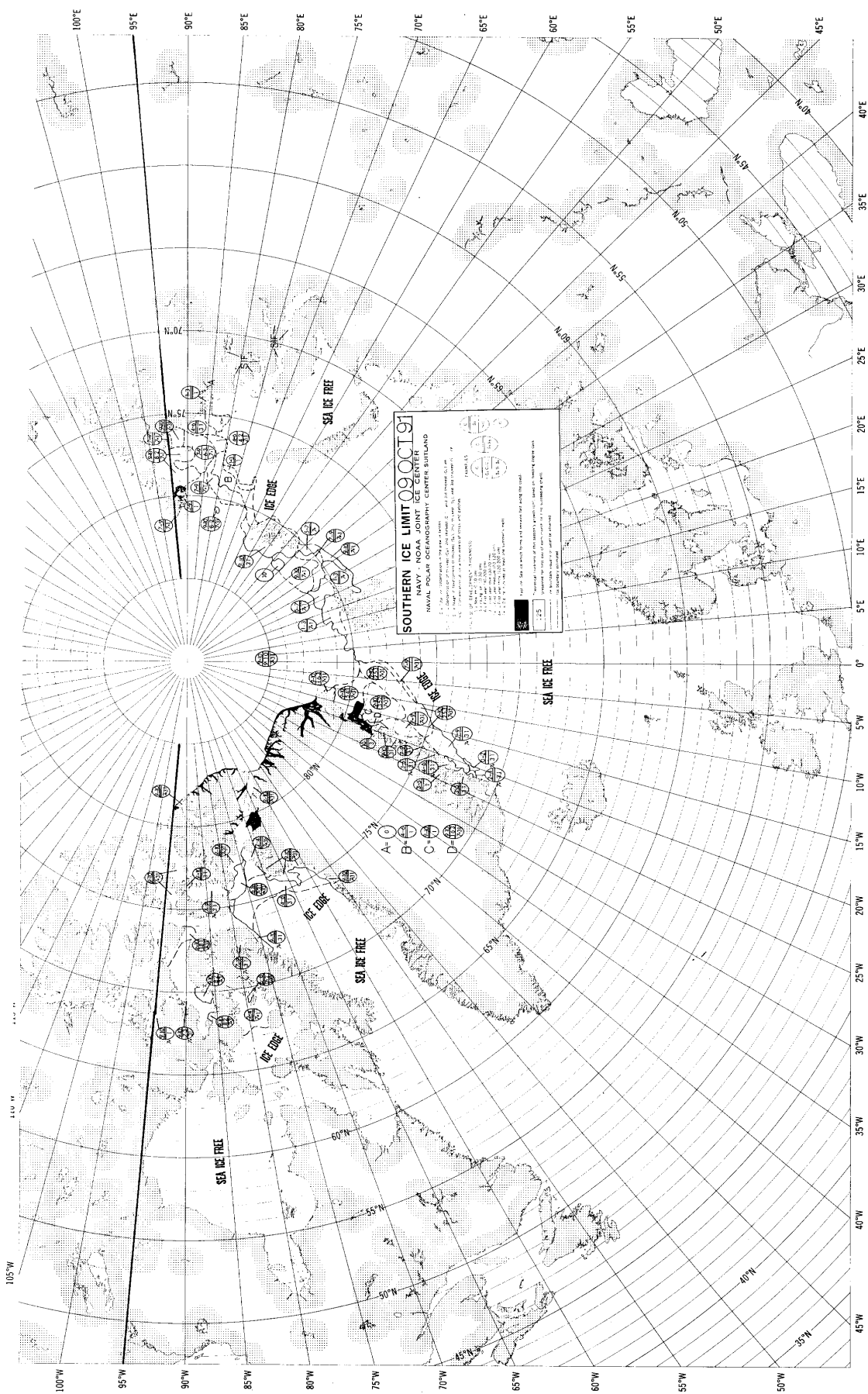
10. The map is a representation of the sea ice limit in the Southern Ocean, based on data collected by the U.S. Navy's Polar Océanography Center, Station 125, during the period 01 September 01 to 04 September 01.

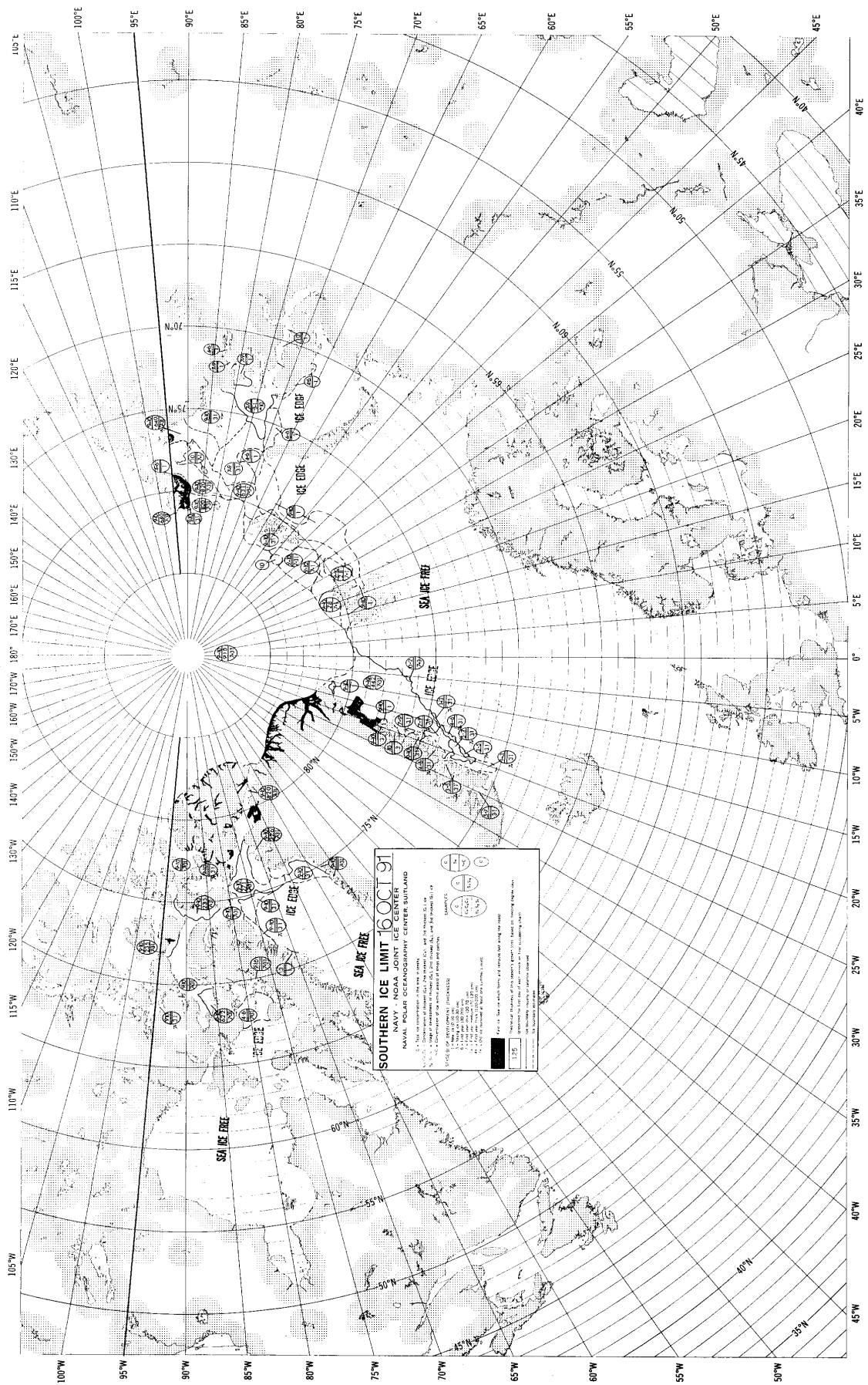


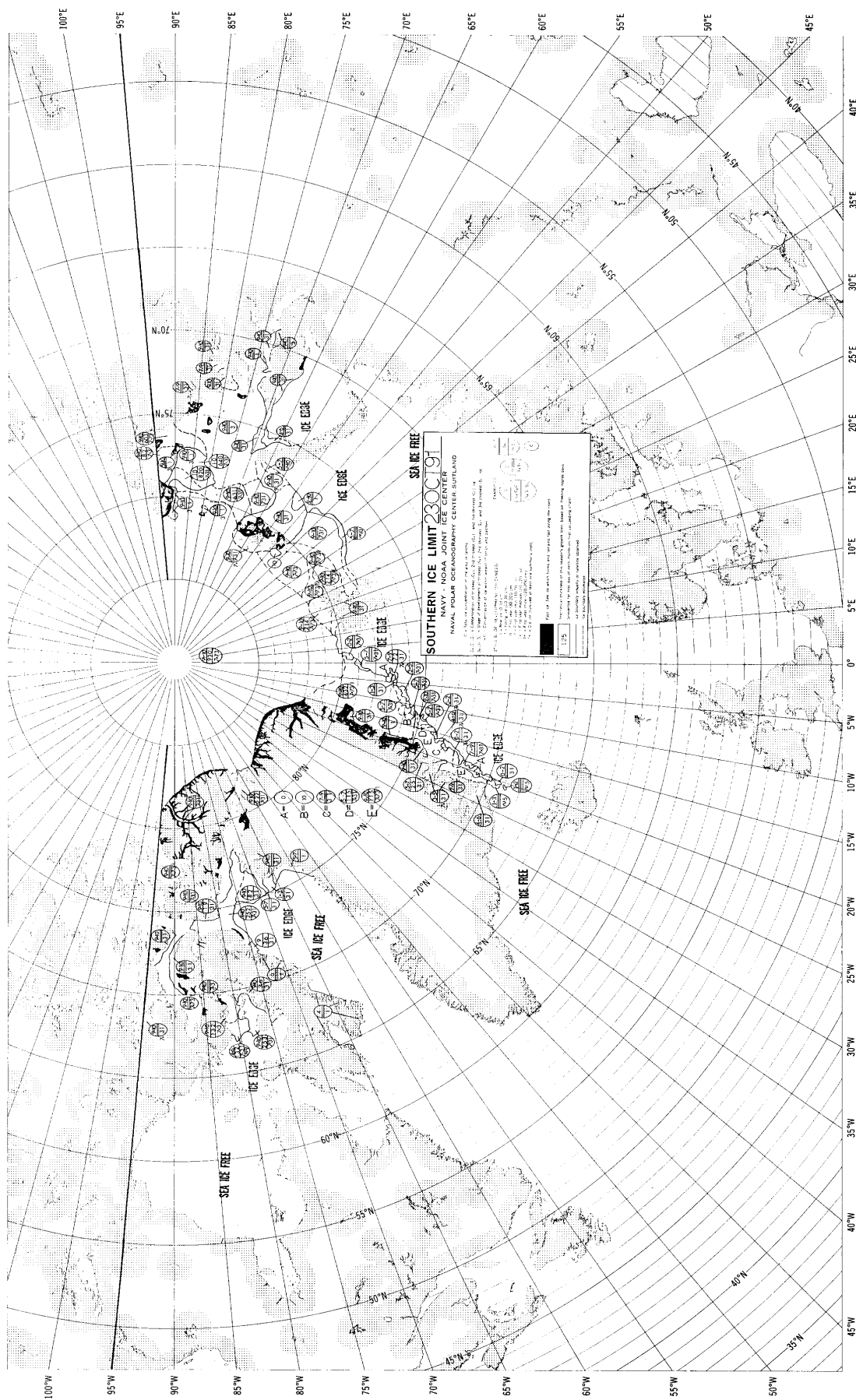


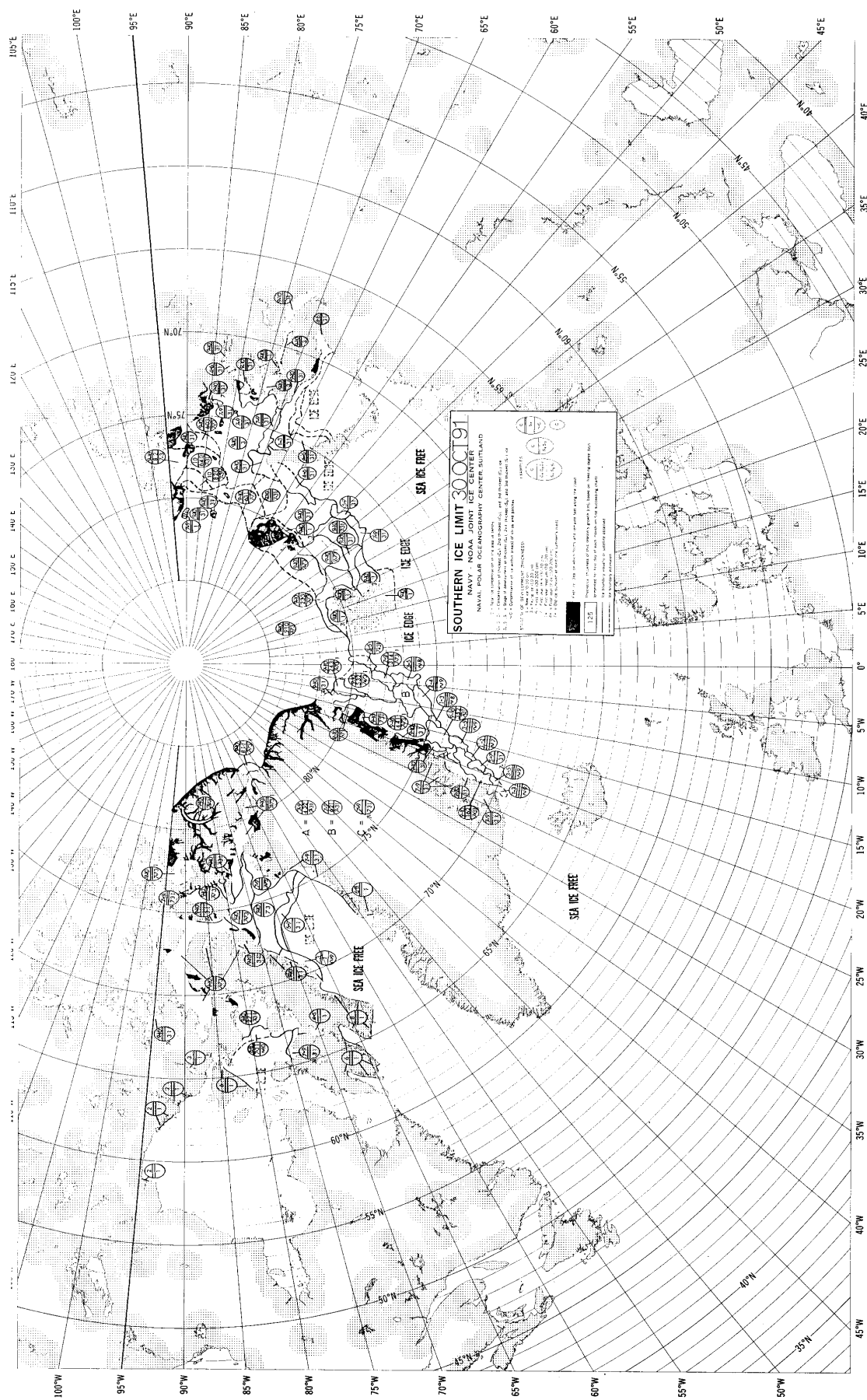


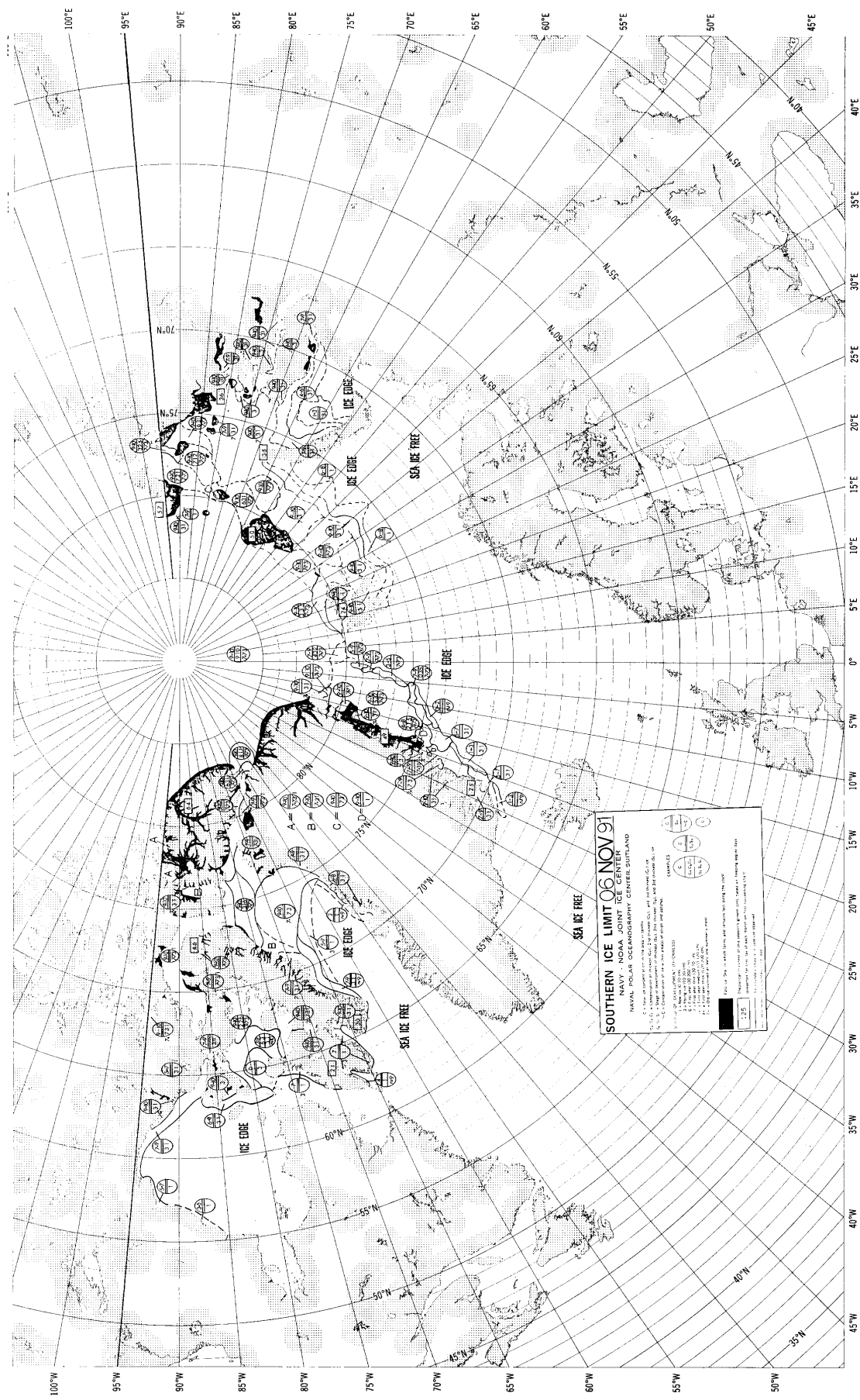












SOUTHERN ICE LIMIT 06 NOV 91
NAVAL NAVY - NOAA JOINT ICE CENTER

1. This map shows the limits of sea ice in the Southern Ocean as of 06 NOV 91. The limits are based on the latest available data from the Navy and NOAA.

2. The limits are shown as a solid line for the inner limit and a dashed line for the outer limit.

3. The areas between the limits are labeled as follows:

- A - Sea ice free
- B - Sea ice free
- C - Sea ice free
- D - Sea ice free

4. The map is based on the latest available data from the Navy and NOAA.

5. The map is based on the latest available data from the Navy and NOAA.

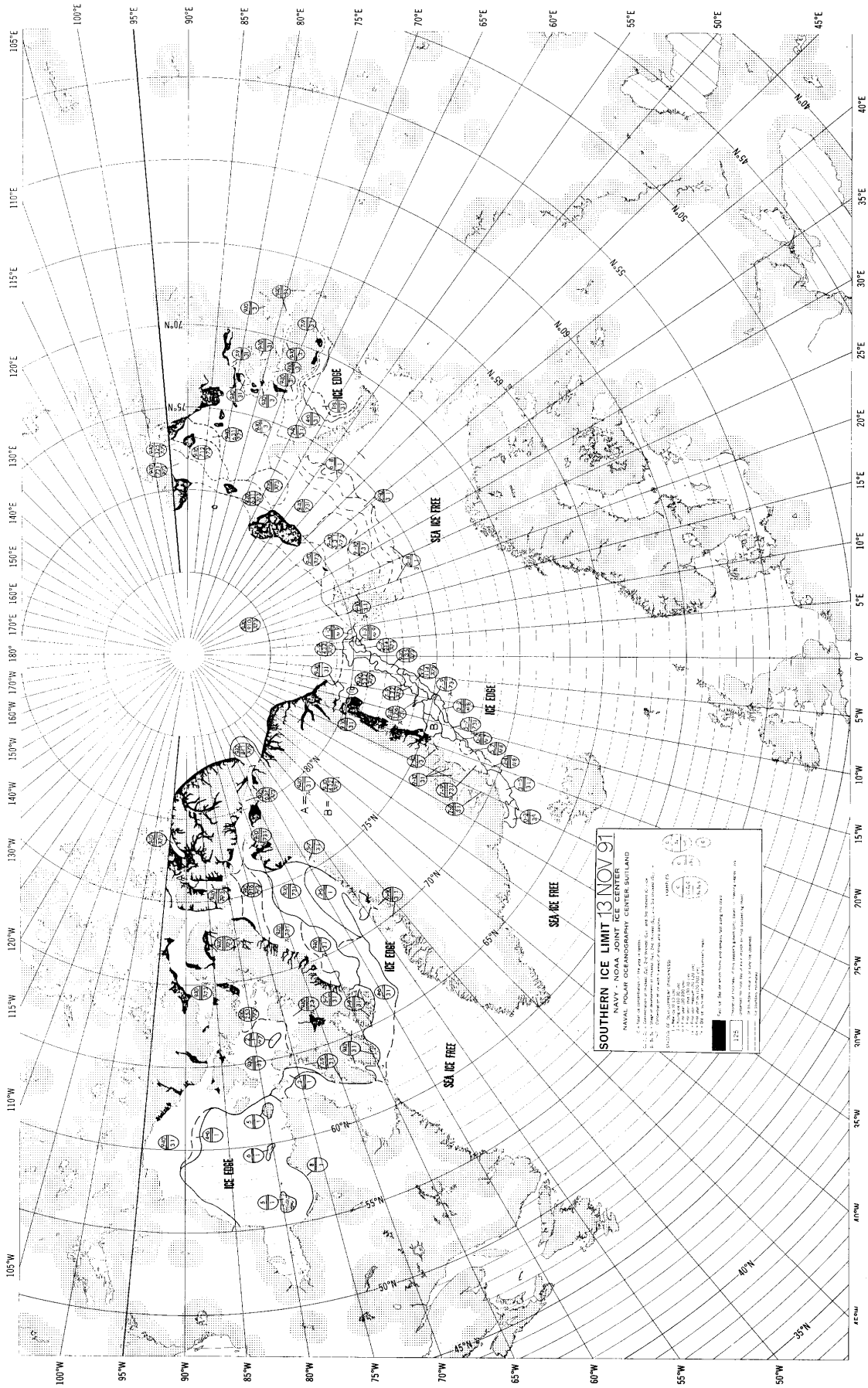
6. The map is based on the latest available data from the Navy and NOAA.

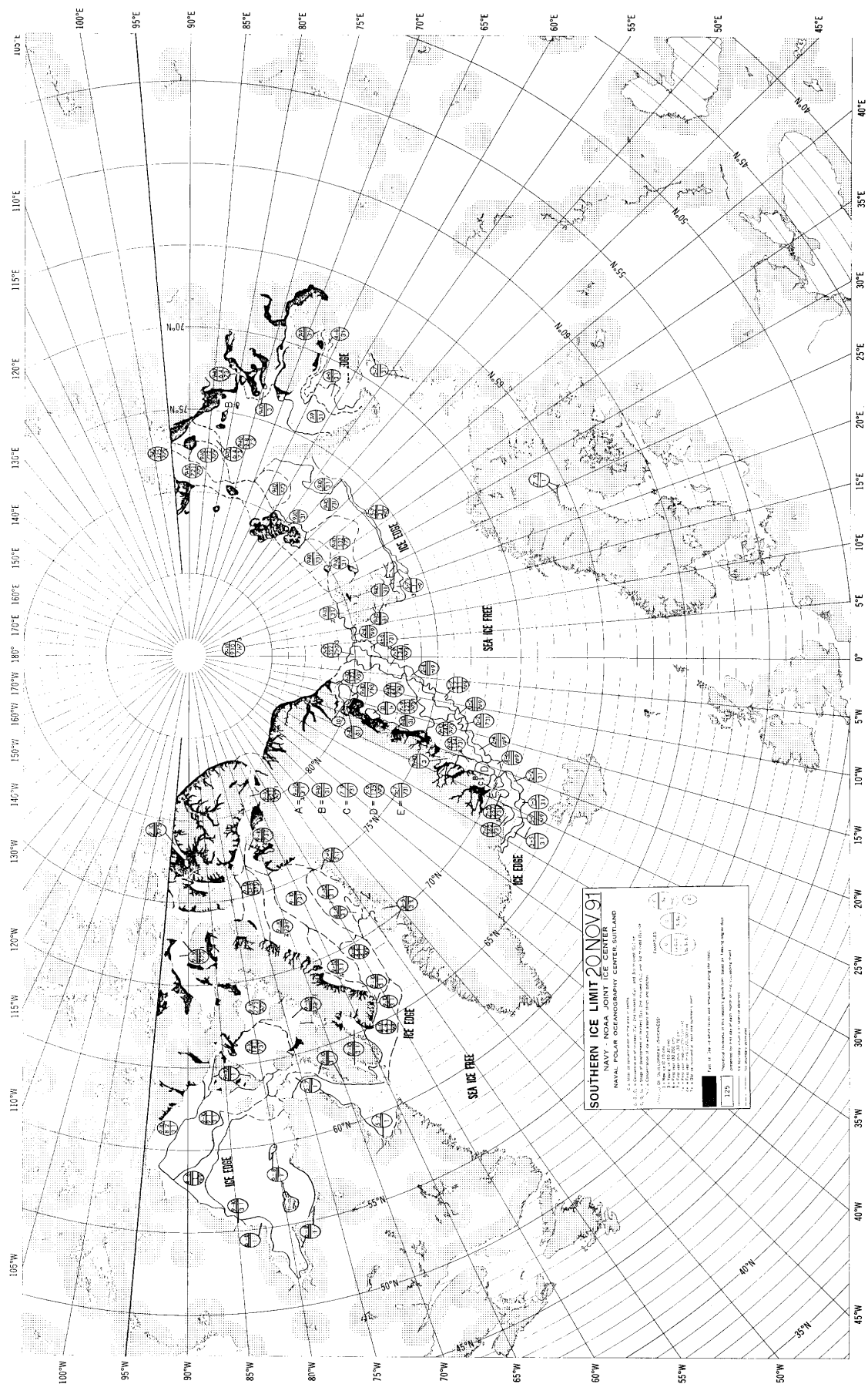
7. The map is based on the latest available data from the Navy and NOAA.

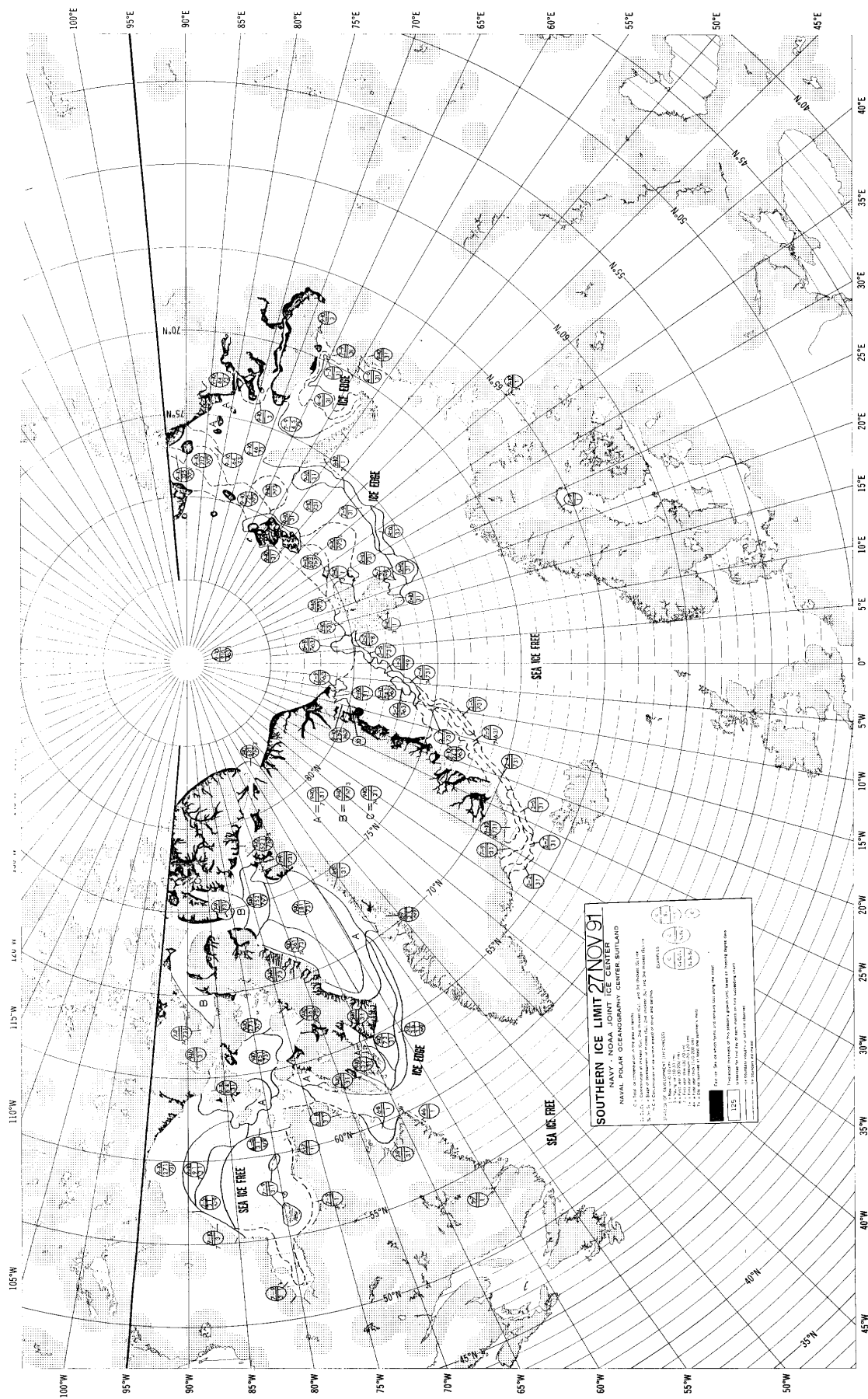
8. The map is based on the latest available data from the Navy and NOAA.

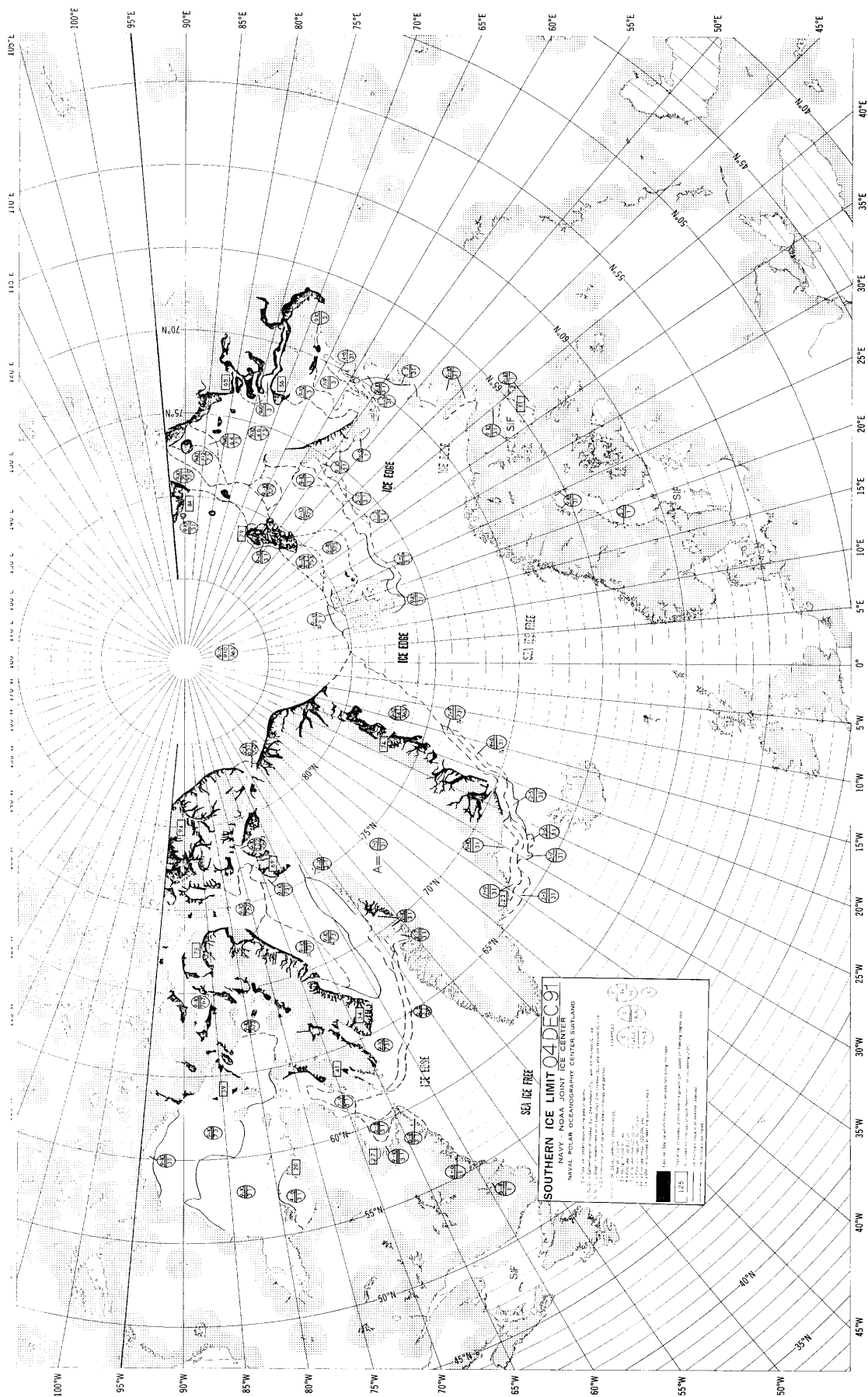
9. The map is based on the latest available data from the Navy and NOAA.

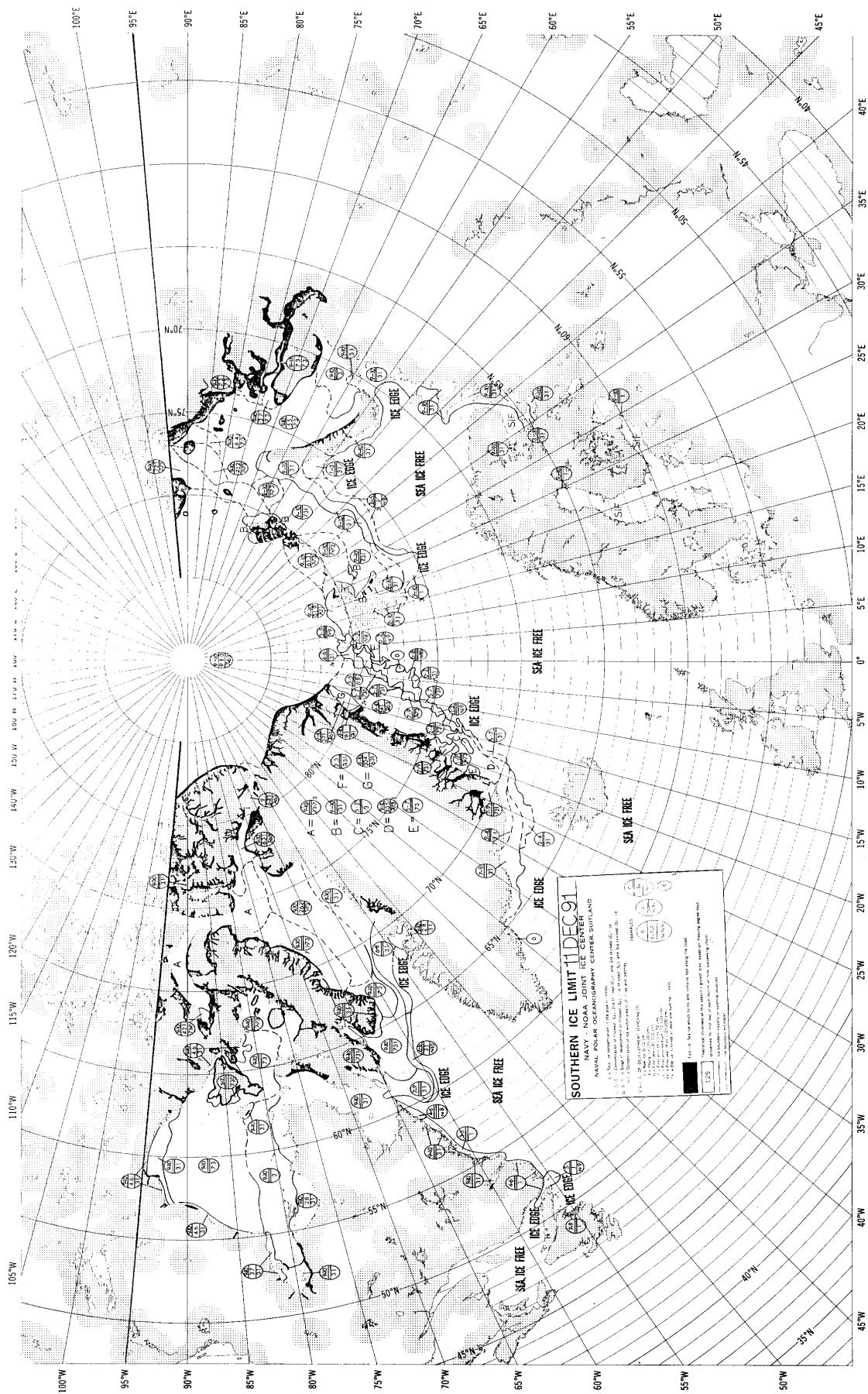
10. The map is based on the latest available data from the Navy and NOAA.

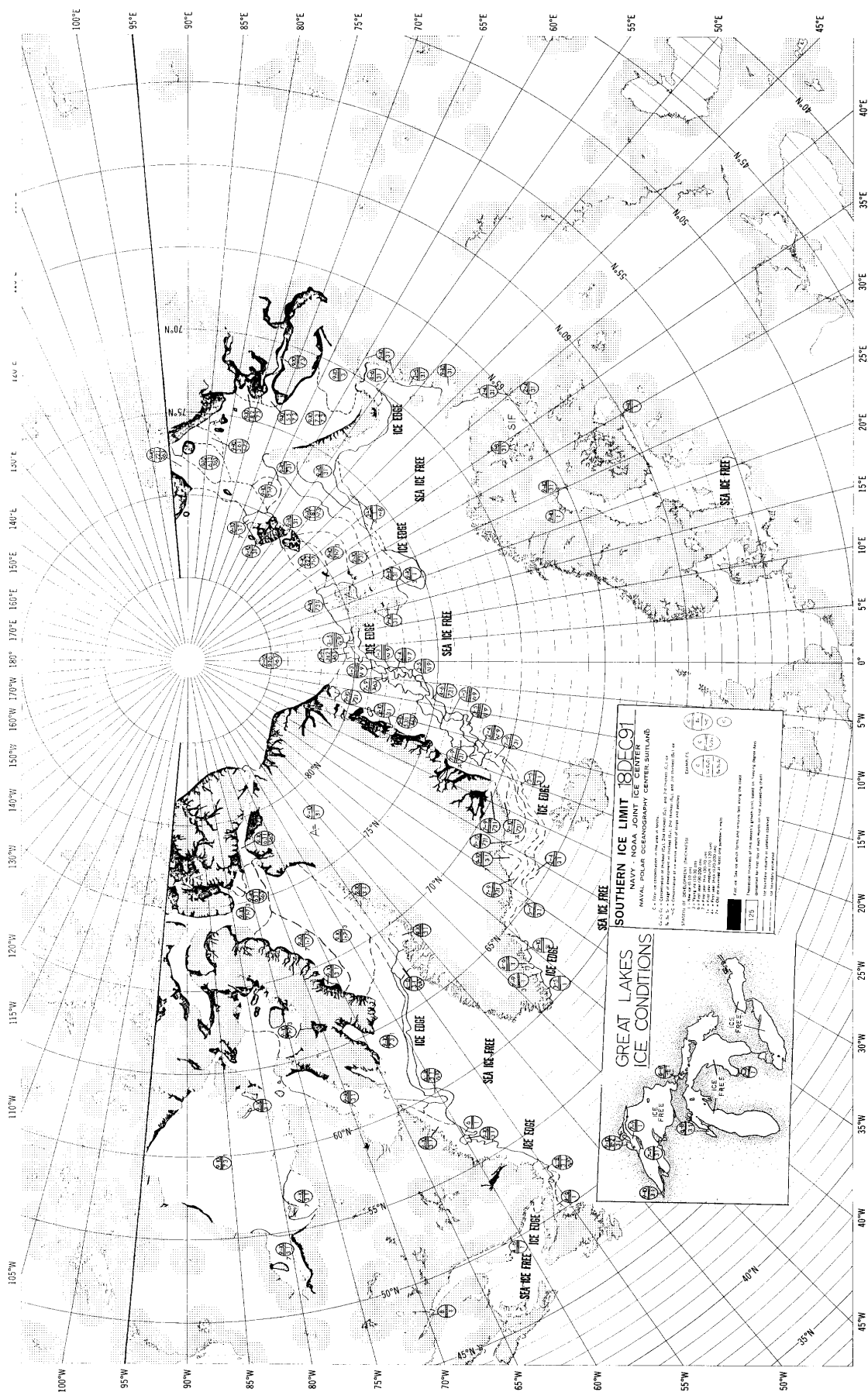












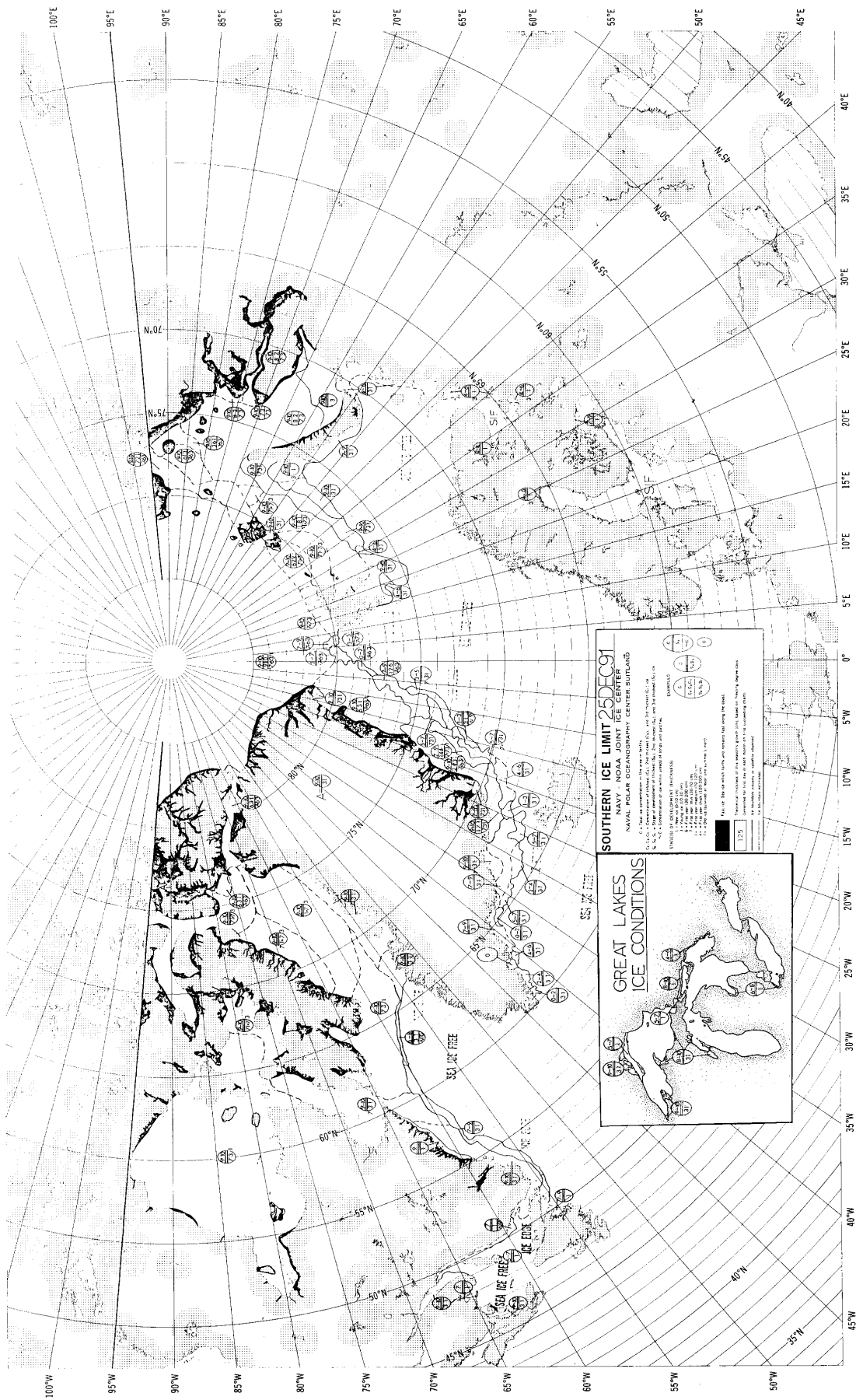


TABLE 1. SATELLITE DATA UTILIZED DURING 1991 (ARCTIC)

Time period		Satellite Remote Sensing			
From	To	Sensor Platform	Sensor Type	Spectral Region	Resolution Coverage
1-91	9-91	NOAA-10	AVHRR HRPT/LAC VIS NIR IR	0.58-0.68 um 0.725-1.10 um 10.5-11.5 um	1 km Regional
			GAC VIS IR	0.58-0.68 um 10.5-11.5 um	4 km Global
1-91	12-91	NOAA-11	AVHRR HRPT/LAC VIS NIR IR	0.58-0.68 um 0.725-1.10 um 10.5-11.5 um	1 km Regional
			GAC VIS IR	0.58-0.68 um 10.5-11.5 um	4 km Regional
1-91	12-91	DMSP-F (10/11)	OLS VIS IR SSM/I MW	0.4-1.1 um 10.2-12.8 um 1.55 cm (19.35 GHz) 0.81 cm (37.0 GHz)	.62 km Regional .62 km Regional 50 km Global 35 km Global
9-91	12-91	NOAA-12	AVHRR HRPT/LAC VIS NIR IR	0.58-0.68 um 0.725-1.10 um 10.5-11.5 um	1 km Regional

Abbreviations and Acronyms

AVHRR - Advanced Very High Resolution Radiometer
 cm - Centimeter
 GAC - Global Area Coverage
 GHz - Giga-hertz
 HRPT - High Resolution Picture Transmission
 IR - Infrared
 km - Kilometer
 LAC - Local Area Coverage
 MW - Microwave
 NIR - Near Infrared
 OLS - Operational Line Scan System
 SSM/I - Special Sensor Microwave Imager
 um - Micrometer
 VIS - Visible